

PREFERRED ALTERNATIVE REPORT

Vehicle Technology, Alignment & Guideway, Stops & Vehicle Maintenance Facility
DRAFT - April 2019



Prepared for:
City of Tampa

Prepared by:
HDR



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1. INTRODUCTION

1.1 Report Contents

This report provides a review of the project purpose and need statement, a review of alignment options evaluated during the first phase of the study, and a presentation of preferred project alternatives, including preferences for the following:

- » vehicle technology;
- » extension alignment and guideway;
- » existing guideway modernization;
- » stop concepts and locations; and
- » vehicle maintenance facility improvements.

The final section of this report summarizes engagement activities undertaken throughout the study to support project decisions.

The Preferred Alternative Report summarizes detailed information and analyses that can be found on the City of Tampa's *InVision: Tampa Streetcar* project website: www.tampagov.net/streetcar.

1.2 Study Background

The City of Tampa is conducting the *InVision: Tampa Streetcar Feasibility Study* to evaluate the potential modernization and extension of the Tampa Historic Streetcar System to better serve the mobility needs of residents, workers, visitors, and students in Downtown Tampa, Ybor City, Channel District, and surrounding urban neighborhoods. The planning and design effort is designed to advance mobility goals and strategies presented in the *InVision: Tampa Center City Plan* and build on previous studies assessing Downtown Tampa's transportation needs.

The current Tampa Historic Streetcar System is a 2.7-mile-long, fixed guideway transit service connecting destinations in Downtown Tampa, Channel District, and Ybor City. Since the start of revenue service on Phase I (Ybor City to Convention Center) in October 2002 and opening of the Phase II-a (Convention Center to Whiting Street) in December 2010, the system has provided connections between Ybor City and key visitor destinations and event venues. The system currently connects the Tampa Aquarium, Tampa Bay History Center, Amalie Arena, and the Tampa Convention Center.

In recent years, ridership on the existing system has been lower than anticipated due to several factors, including limited hours of operation, low service frequency, and lack of connectivity to important transit trip attractors and generators in the Downtown Core, including commercial and governmental offices, multifamily development, and the Marion Transit Center.

In October 2018, supported by a three-year FDOT grant, HART initiated service improvements that have resulted in significant increases in ridership. These improvements, which include fare-free service, longer operation hours, and greater service frequency, have attracted more than 180,000 additional riders in the first 4 months of implementation, nearly tripling ridership over the same period the previous year.

With additional improvements, introduction of accessible, higher capacity vehicles, and extension through the Downtown core, the service has the potential to become an attractive transportation option for a broader cross-section of downtown residents, workers, students, and visitors, as well as serve as a catalyst for reinvestment and economic development.

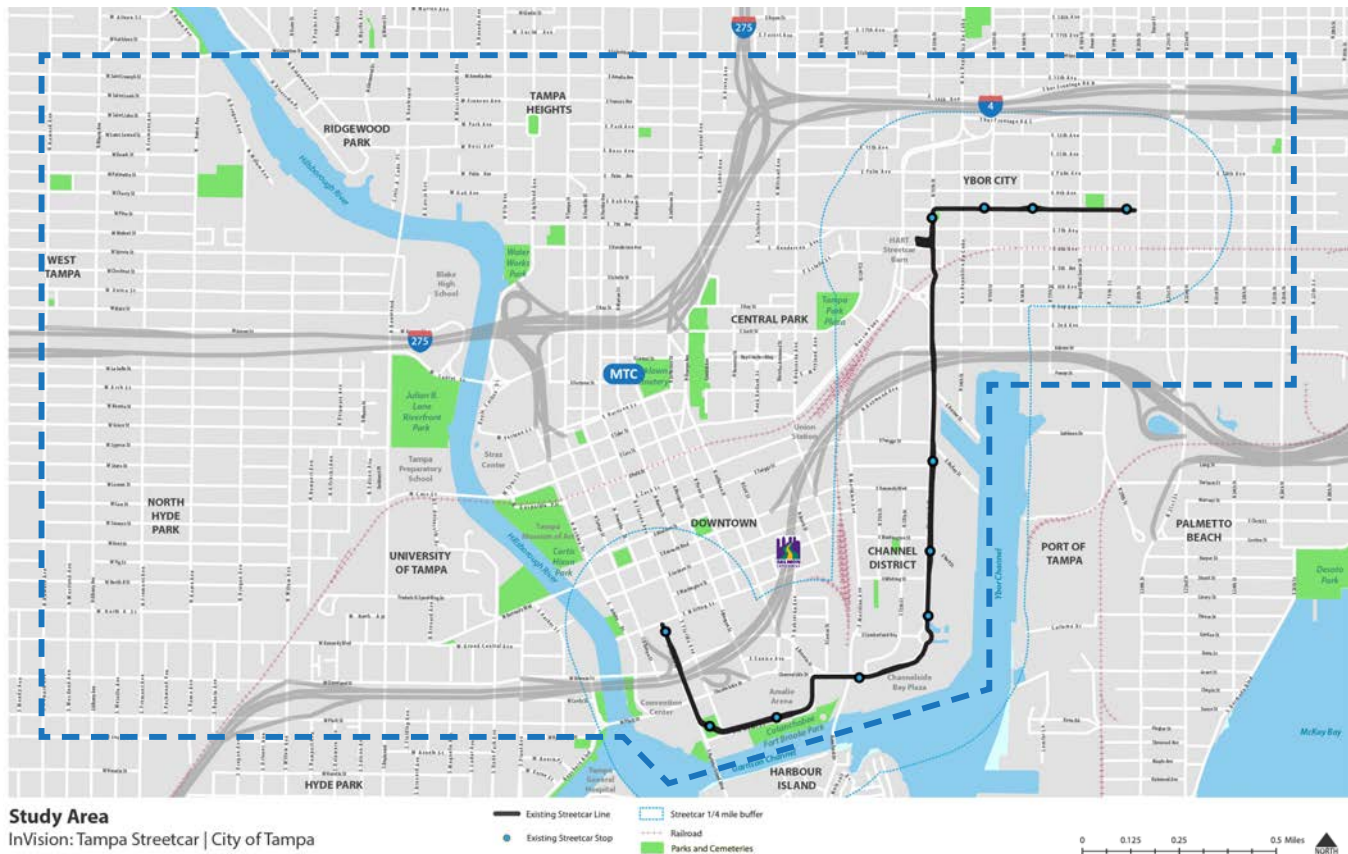
1.3 Study Overview

The *InVision: Tampa Streetcar Feasibility Study* has been undertaken to define and evaluate modernization options for the existing streetcar system and facilities, assess the potential for an extension of the system, and evaluate vehicle technology alternatives. The study is being led by the City of Tampa in partnership with the Florida Department of Transportation (FDOT) and the Hillsborough Area Regional Transit Authority (HART). The project is being developed in close coordination with other local and regional transit initiatives, including the HART *Regional Transit Feasibility Plan*.

As shown on Figure 1, the area under evaluation for the study matches the area defined for the *InVision: Tampa Center City Plan* and measures approximately three-miles by two-miles centered on the Downtown Core.

The study has proceeded under two phases of work. During the first phase of the study, the City completed assessments of land use and transportation conditions

Figure 1. InVision: Tampa Streetcar Feasibility Study Area



in the study area, prepared a purpose and need statement, and evaluated multiple alignments for the extension of the system through Downtown and surrounding urban neighborhoods. These efforts, including a series of public and stakeholder meetings held in the spring and fall of 2017, resulted in the identification of two north/south-oriented alignments as the best performing options for advancement into the second phase of the study (See Figure 3).

The first phase also resulted in a recommendation to improve service on the existing streetcar alignment between Ybor City, Channel District, Water Street, and the Tampa Convention Center. Recommendations called for the full alignment—the existing system plus the extension—to be designed to provide a “one seat” trip, maximize exclusive transit guideway operations, and offer high levels of service with full-day and evening operations with 15-minute service frequency.

During the second phase of the study, the two north/south-oriented alignments were evaluated in greater detail and additional analysis was conducted to determine preferences for vehicle technology, guideway configurations, stop locations and concepts, modernization improvements along the existing system, and potential improvements to the vehicle maintenance facility.

The results of these initial phases of the study will serve as the basis for the assessment of environmental impacts, preparation of ridership and cost estimates, and the drafting of a project funding and implementation plan.

2. PURPOSE & NEED

Project research and feedback from public and stakeholder engagement during the first phase of the study established a foundation for the development of the project purpose and need statement. The purpose and need statement articulates issues and opportunities that may be addressed through the introduction of enhanced transit service. The statement served as the basis for evaluating initial alignment options and defining and selecting preferred project alternatives.

A summary of the project purpose and need statement follows:

» **Connect Downtown Centers.** Tampa's downtown has undergone a dramatic transformation in the past decade. The Downtown Core, Channel District, and north Harbour Island are now home to nearly 10,000 residents, and another 40,000 people reside in revitalizing districts surrounding the Downtown Core, including Central Park, Ybor City, North Hyde Park, Grand Central, and Tampa Heights. The number of employees in the study area has increased during the same period to around 100,000 and an additional 34,000 employees are projected in the study area between the years 2020 and 2040. As activity levels have increased, travel within and between downtown destinations has become increasingly time-consuming, costly, and inconvenient. Single occupancy vehicle travel is difficult given traffic congestion and diminished parking availability. Distance and physical barriers make walking an unattractive option for all but very short trips, particularly during hot weather,

and although the existing streetcar connects some key destinations, many important ones are beyond walking distance of the system and alternative transit service is limited.

» **Serve Diverse Travel Markets.** As the traditional center of employment, governmental services, culture and history, and entertainment, Downtown Tampa serves a broad range of users from across the Tampa Bay region. Downtown residents, workers, and visitors travel to and within Downtown Tampa to conduct business, access public services, participate in educational programs, and enjoy sports, cultural, and entertainment events. These users place a strong and consistent demand on existing transportation, transit, and parking resources. And as these numbers increase—population and employment alone are projected to increase by 65,000 in the study area between 2020 and 2040—existing facilities will come under increasing stress. The introduction of a high capacity, reliable, and consistent circulator service could meet increased demands while also more efficiently use existing roadway capacity and street space. An improved service could help meet the demands of transit-dependent populations in downtown-adjacent neighborhoods, as well as meet the needs of downtown's growing residential and student populations, event and venue patrons, conventioners, and workers.

Figure 2. Images from early project workshops held in April and May 2017



- » **Improve First/Last Mile Service.** Although several regional transit services provide access to Downtown Tampa and significant investment has been made in public parking infrastructure, first mile/last mile transit between these and Downtown destinations are limited. While regional transit services like HART and PSTA express bus, Amtrak, and private regional bus operations cater to a wide range of users and geographical reaches, there is no single unifying service that addresses first/last mile mobility for large numbers of daily regional commuters and public parking users. A high-capacity, scheduled service that allows for frequent and efficient transfers to and from regional transit modes and parking resources is missing in the service area. Such a service could complement existing bike sharing, ride hailing, and limited capacity public transit services like the In-Towner and Downtowner.
- » **Support Economic Development.** Investment in large-scale, multi-block, mixed use projects, including Water Street, The Heights, West River, and Port Tampa Bay, will have a dramatic impact on the future of the City and region. These projects, representing over six billion dollars in private investment, will reshape large sections of Downtown Tampa and surrounding neighborhoods. These projects, along with the continued revitalization of Ybor City, the North Franklin Street Corridor, and build out of the Channel District and Encore, will create new travel demand in and between locations not currently well-served by convenient, high capacity mobility services. Given spatial and physical barriers to walking, travel within and between downtown destinations and emerging development areas is often time-consuming and inconvenient. A core transit service linking planned population and employment concentrations will help bridge the distances across Downtown Tampa and connect adjacent subdistricts more directly to destinations, amenities, and activities.
- » **Expand Sustainable Transportation Options.** Without improved local transit options, Downtown Tampa's long term sustainability and competitiveness will be diminished. Several factors limit the potential to improve access and mobility by automobile travel—downtown's location on a peninsula creates natural access and mobility challenges, roadway and parking capacity is limited, and the distance between regional transit hubs, subdistricts, and destinations makes pedestrian travel an impractical alternative for mid-range local trips. A core transit service with the potential to serve internal trips effectively, bypass peak hour and event-related congestion, integrate with on-demand and private ride-hailing services, and leverage the presence of regional transit connections and parking resources has the potential to support City goals for a more sustainable, livable, and energy-efficient future.

The full purpose and need statement is included in the *Purpose & Need, Context & Evaluation Report* available on City of Tampa's *InVision: Tampa Streetcar* project website: www.tampagov.net/streetcar..

3. EXTENSION OPTIONS

3.1 Extension Options Development & Evaluation

Early in the study process, seven alignment options were defined based on the results of the context assessment and feedback from public and stakeholder engagement activities. These alignment options included:

- » Alignment A: N/S Franklin Street
- » Alignment B: N/S Tampa Street-Florida Avenue Couplet
- » Alignment C: E/W West River-Ybor City
- » Alignment D: E/W North Hyde Park-Channel District
- » Alignment E: E/W North Hyde Park-Convention Center Couplet
- » Alignment F: Loop Downtown-Channel District
- » Alignment G: Loop Downtown-Ybor City

These alignment options were evaluated based on measures associated with the purpose and need categories, as well as six performance and impact categories. The measures used for the performance and impact categories are shown in Table 1. The full results of the alignment option evaluation process are reported in a summary matrix and an overall evaluation matrix provided in Appendix A - Alignment Options Evaluation Process.

3.2 Preferred Extension Options

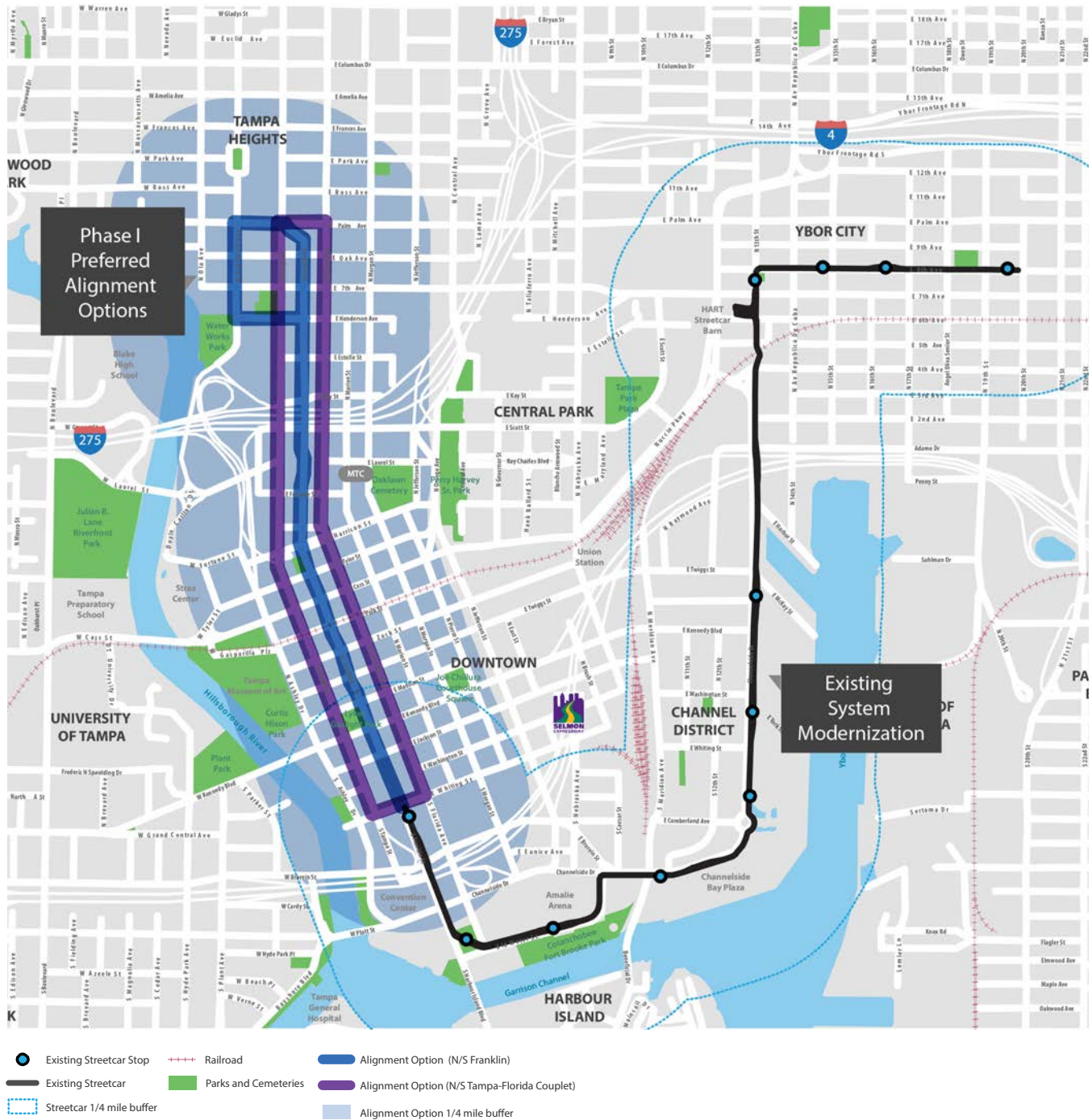
The alignment option evaluation effort resulted in the selection of Alignment Options A (N/S Franklin Street) and B (N/S Tampa Street-Florida Avenue Couplet). These alignment options performed above average in the purpose and need evaluation categories and were rated highly in the performance and impacts categories. Both options serve residents, employees, and special event venues in the Downtown Core, provide service to existing and potential regional transit hubs, including the Marion Transit Center, and were highly rated due to comparatively lower capital and operating costs.

For more detailed information on the alignment option evaluation and selection process, refer to the full report—*Definition & Evaluation of Alignment Options Report*—on the City of Tampa's InVision: Tampa Streetcar project website at www.tampagov.net/streetcar.

Table 1. Performance & Impact Evaluation Categories and Measures

Category	Measure
Population & Employment Served	Population/employment within 1/4 mile per track mile (2020)
	Population/employment within 1/4 mile per track mile (2024)
Capital & Operating Costs	Total capital cost (2017\$) - mid-range (extension & new vehicle cost only)
	Annual O&M costs (2017\$) - extension only
Cost Effectiveness	Capital cost (2017\$) per track mile
	Annualized capital & O&M cost (2017\$) per rider (2020)
Constructability /Operational Constraints	Avoids CSX railroad crossings
	Avoids river crossings
	Avoids Esplanade crossing
	Minimizes or avoids other constraints that would affect streetcar operations
	Avoids or minimizes impacts to major utilities
Traffic & Parking Impacts	Minimizes or avoids increases in roadway congestion (2020 existing roadway capacity)
	Provides potential for dedicated guideway based on adjusted roadway capacity
	Avoids or minimizes reduction in on-street parking
	Avoids or minimizes potential for intersection failure
Community & Environmental Impacts	Serves Environmental Justice (EJ) populations with minimal impacts
	Minimizes impacts to business access
	Minimizes or avoids impacts to noise/vibration-sensitive uses
	Minimizes potential impacts to historic districts
	Avoids potential impacts to parklands or other Section 4(f) resources

Figure 3. Alignment Options A and B



4. PREFERRED ALTERNATIVE

4.1 Definition & Evaluation of Project Alternatives

Following the alignment option selection, attention focused on defining a locally preferred alternative addressing the following elements of the project:

- » vehicle technology;
- » alignment and guideway concepts, including existing guideway modifications;
- » stop locations and design concepts; and
- » vehicle maintenance facility concepts.

In partnership with FDOT and HART, the City worked with local leaders, key stakeholders, and the general public through the process of evaluating and selecting preferred project alternatives to advance into the project development phase of the study.

A review of the preferred alternative and concepts for each project elements is provided below.

4.2 Vehicle Technology

This section of the report reviews the vehicle technology evaluation process that resulted in selection of modern streetcar vehicles as the preferred vehicle type for the system. The section also includes information regarding design considerations associated with modern streetcar operations and provides information on specific models which may be available for use on the system.

VEHICLE TECHNOLOGY EVALUATION

Methodology

The vehicle technology evaluation compared performance characteristics and costs of different transit vehicle technologies operating along the existing 2.7-mile streetcar line and the proposed Tampa Street-Florida Avenue extension.

For the purpose of the evaluation, it was assumed the service would operate mostly in an exclusive guideway and provide a one-seat trip from Ybor City to Tampa Heights along the existing line and the proposed

extension with no change in vehicle technology. The comparative analysis considered the performance and costs implications of the following vehicle technologies:

- » continued use of the existing TECO historic replica streetcars and related infrastructure;
- » replacement of existing historic replica streetcars with modern streetcar technology and infrastructure; and,
- » replacement of existing historic replica streetcars with premium bus technology and infrastructure.

The comparison considered key factors associated with each of the three transit technologies. Holding route and service characteristics constant among the three vehicle technologies, the analysis estimated operating costs, capital costs, and how each of those compared to the number of potential riders carried by each vehicle at maximum capacity. The analysis estimated fleet size required to provide 15-minute headway service over the route, as well as the annual number of service hours needed to meet that frequency. These were the core components used to calculate approximate annual operating costs. To equalize the cost across technologies, an annual cost per rider was calculated that took into account each technology's carrying capacity. Other considerations in the analysis included ride quality, image and community enthusiasm, accessibility—ADA and others (strollers, bikes)—life cycle costs, environmental sensitivity, and economic development impacts.

Vehicle Technology Selection

Of the three technologies studied, the modern streetcar most closely aligned with the local objectives, as expressed in the purpose and need statement, for a transit system serving greater Downtown Tampa. The modern streetcar provides the highest-capacity vehicle of the options considered. The configuration of the modern streetcar, with multiple, wide doors and level-boarding heights, would facilitate easy access by the greatest share of the population, including those with mobility challenges. With many portions of the route in a dedicated guideway, a modern streetcar would be able to move large numbers of people while minimizing constraints posed by traffic congestion.

The modern streetcar would also be an effective way to connect the downtown with neighboring districts, and to provide first/last mile service as a central component of the regional transit system. The streetcar's operation at street level in a dense urban environment, with frequent stops and easy boarding, make it an attractive and reliable service with "hop on/hop off" convenience. The tracks in the street provide a psychological assurance to riders that the route is fixed, and frequent service and real-time information allow riders to access the system without consulting a time table. These features, along with the modern streetcar's comfort and capacity, attract regular riders who will make the streetcar part of their daily travel solution. Furthermore, the proposed extension along the Tampa-Florida couplet provides a strong connection to HART's Marion Transit Center, as well as easy transfers to numerous HART bus routes along the alignment.

While the modern streetcar is the most expensive of the three technologies to construct and operate in absolute terms, its larger passenger capacity makes it the most efficient of the options in terms of cost per rider. In a rapidly-growing urban center like Tampa, this capacity provides the greatest degree of system flexibility for meeting mobility demands on a day-to-day basis, and over the long term.

For more information on the vehicle technology evaluation, please refer to the full report—*Vehicle Technology Comparison Technical Memorandum*—on the City of Tampa's InVision: Tampa Streetcar project website at www.tampagov.net/streetcar.

MODERN STREETCAR CHARACTERISTICS & SUPPLIERS

Standards for Conceptual Planning

Although a specific vehicle supplier and model will not be selected until the engineering phase, information regarding design requirements for modern streetcars has been used during the conceptual planning and design. Modern streetcar vehicles, regardless of model, share several characteristics which have informed the team's early work, including high passenger capacity; guideway dimension, track gauge, and overhead power; low floor configurations at primary boarding locations allowing for level boarding; and turning radii greater than required for the existing replica vehicles. In cases where more specific vehicle specifications were required, e.g. in conceptual planning for the vehicle maintenance facility, the study team referenced specifications for the Siemens S70 Short vehicle, which is one of the longer vehicles currently available to serve the U.S. market. Use of the S70 Short specifications allows for future flexibility in selection of the S70 vehicle or a vehicle from another supplier.

Table 2. General Technical Details for Current Active US Streetcar Suppliers

Criteria	Carbuilder		
Manufacturer	Brookville	CAF	Siemens
Model	Liberty	Urbos 3	S70 Short
Length	69 ft.*	74 ft.	82 ft.
Width	8.1 ft./8.7 ft.	8.1 ft./8.7 ft.	8.7 ft.
Low Floor	50%	100%	70%
Min Turning Radius	59 ft.	66 ft.	66 ft.
Seats/AW2 Load	43(+4)/90	32(+6)/116	52(+8)/90
Total Capacity	137	154	146
ADA Access	Level/Bridgeplate	Level	Level/Bridgeplate
Off Wire	Yes	Yes	Yes
Distance between Doors w/ Level Boarding	18 ft.	60 ft.	48 ft.
Doors/Side	2 (2 DBL)	4 (2 DBL, 2 Single)	4 (4 DBL)

* The Brookville streetcar proposed for Tempe will be longer than the cars previously built to conform to the ASME RT-1 requirements for crash energy management.

Vehicle Suppliers & Specifications

Currently, three suppliers are active in delivering modern streetcars to systems in the United States— Brookville Equipment Corporation of Brookville, PA; CAF, headquartered in Spain with a final assembly facility in Elmira, NY; and Siemens, building cars in Sacramento, CA. Each use a different vehicle platform but share common characteristics, and all have proven capable of meeting FTA Buy America requirements. Photographs and floor plans for each are provided in Figures 4 through 8. A summary of the general specifications for each is provided in Table 2.

Other streetcar suppliers operate in North America, including Alstom, Bombardier, and Stadler, and may be able to provide vehicles adaptable for use in Tampa. While these suppliers have facilities within the United States and could possibly provide domestically-built and/or Buy America-compliant streetcars, they have not proposed on any streetcar procurements likely due to the small quantities of cars in each order. It is possible that Skoda, independent of its original partner Inekon for Portland and Tacoma, may be returning to the American market, while the Chinese carbuilder, CRRC, may become an active participant.

We also note that the Toronto Transit Commission (TTC), which is looking to purchase 60 100 percent low floor streetcars, received responses from ten carbuilders in November 2017 to an RFI which they posted in advance of this procurement. These included Bombardier, CAF, three divisions of CRRC, Hyundai Rotem of Korea, Inekon, Siemens, Stadler and Tatra-Yug of the Ukraine. One of TTC's requirements is 25 percent Canadian content.

Table 3 provides information on suppliers and vehicle models delivered through recent vehicle procurements in the United States.

Table 3. Modern Streetcar Suppliers

City	Supplier	Qty	Award	Model	Comments
Portland	Inekon-Skoda	5	1999	Astra	New contract
Tacoma	Inekon-Skoda	3	1999	Astra	Portland option
Portland	Inekon-Skoda	2	1999	Astra	Portland option
Washington, DC	Inekon	3	2004	Trio 12	Portland option
Portland	Inekon	3	2004	Trio 12	Portland option
Seattle	Inekon	3	2004	Trio 12	Portland option
Portland	USC	1	2007	10T3	Prototype
Portland	USC	6	2009	100	New contract
Tucson	USC	7	2010	100	New contract
Atlanta	Siemens	4	2011	S70 Short	UTA Option
Seattle*	Inekon	7	2011	Trio 121	New contract
Cincinnati	CAF	5	2012	Urbos 3	New contract
Kansas City	CAF	4	2012	Urbos 3	Cincinnati option
Tucson	USC	1	2012	100	Tucson option
Washington, DC	USC	3	2012	100	Portland option
Dallas*	Brookville	2	2013	Liberty (N)	New contract
Dallas*	Brookville	2	2015	Liberty (N)	Dallas option
Detroit*	Brookville	6	2015	Liberty (W)	New contract
Milwaukee*	Brookville	5	2015	Liberty (W)	New contract
Charlotte*	Siemens	6	2016	S70 Short	New contract
Oklahoma City*	Brookville	5	2016	Liberty (N)	New contract
Kansas City	CAF	2	2017	Urbos 3	New contract (Sole Source)
Tacoma	Brookville	2	2017	Liberty (N)	New contract
Portland	Brookville	2	2017	Liberty (N)	Tacoma option
Seattle*	CAF	10	2017	Urbos 3 (N)	New contract (on hold)
Tempe*	Brookville	6	2017	Liberty (W)	New contract
Orange County	Siemens	8	2018	S70 Short	New contract

* Equipment for off wire operation

Figure 4. Brookville Liberty Streetcar (Dallas)



Figure 5. Brookville Liberty Streetcar General Arrangement

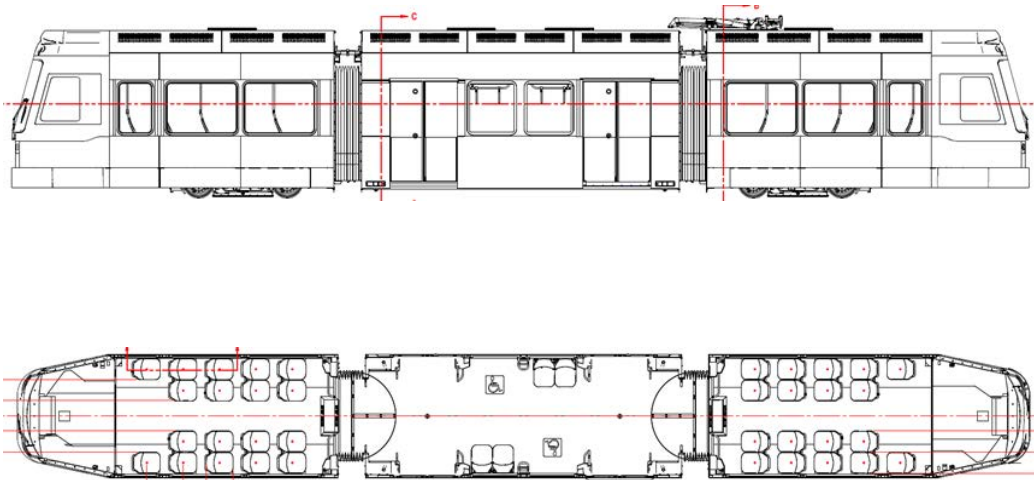


Figure 6. CAF Urbos 3 Streetcar (Cincinnati)



Figure 7. CAF Urbos 3 Streetcar General Arrangement

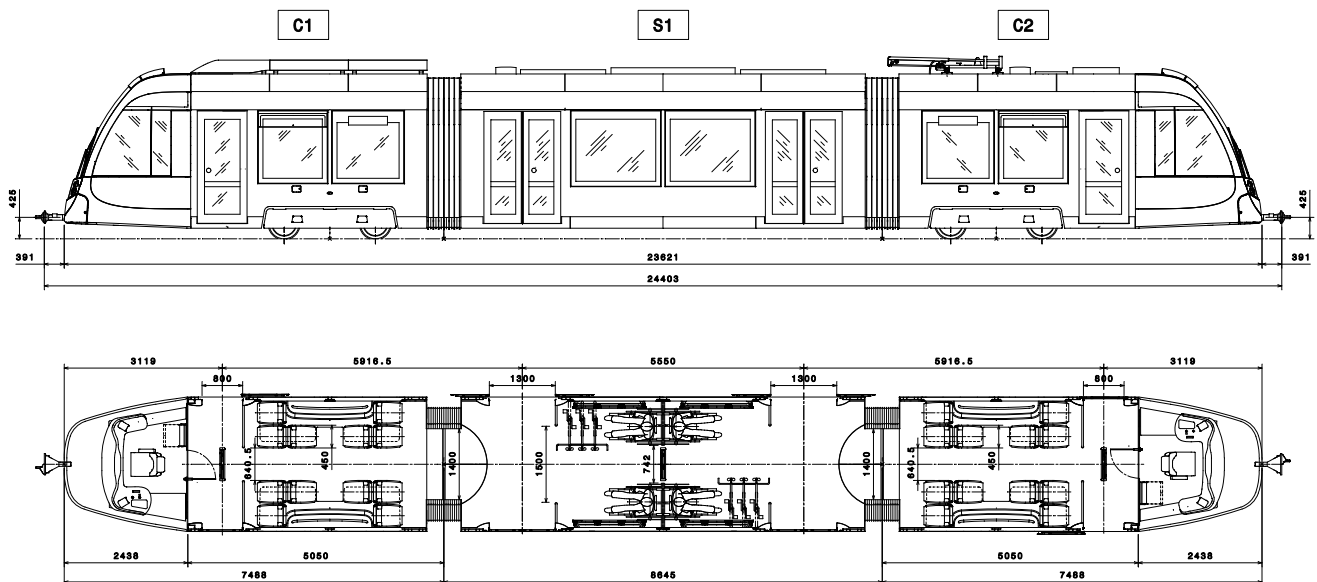
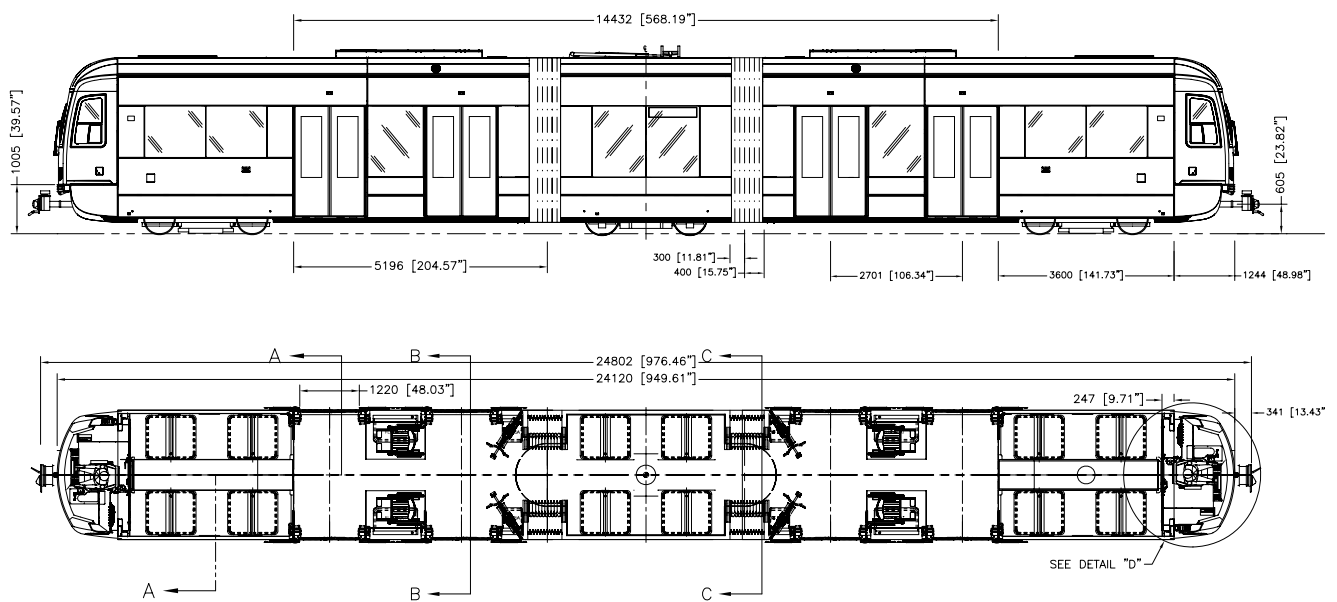


Figure 8. Siemens S70 Short Streetcar (Salt Lake City)



Figure 9. Siemens S70 Short Streetcar General Arrangement



ENGINEERING PHASE DESIGN CONSIDERATIONS

A number of important decisions regarding vehicle specifications, configurations, and performance characteristics will need to be made during the early stages of project engineering. A review of key considerations follows.

Vehicle Access

The Siemens S70 Short streetcar features four double doors on each side. The car length between the front end of the forward-most door and the back end of the rear-most door is 48 feet. Comparatively, the Brookville Liberty streetcar has two doors per side spaced 18 feet apart. The CAF Urbos 3 vehicle has four doors per side with 60 feet between the forward and rear doors. Mobility impaired access is limited to the area adjacent to the two biparting center doors. The distance between the two center doors (front of lead door to rear of trailing door) is approximately 24 feet. Issues that need to be considered in making streetcar configuration selections are discussed below. The cost impacts of implementing these changes are not addressed in this document.

Vehicle Length

The advantage of using a longer car is the greater carrying capacity and therefore improved operational efficiency. The constraints presented in considering a longer car are the length of station platforms, possible need to design for a wider clearance through turns if the distance between the truck centers is longer than the turn, the length of yard storage tracks, and the size of the maintenance shop that would be required to service longer work positions and shop tracks and pits.

Given that Tampa is conceptually planning its system using the longest vehicle, selection of any vehicle presently under consideration will not have a greater impact on the length of the platform and parking places along the alignment. However, the configuration of the station platform, that is the length of the platform over which level boarding can be accommodated, may be impacted by car length. This criterion will be addressed later in this section.

The maintenance facility and rail yard layout may be affected by the length of the vehicle selected. Yard storage tracks and associated ladder tracks must be sized to accommodate the longer cars. The maintenance positions in the shop must also be sized to accommodate a longer vehicle, thereby increasing

the length of the shop facility. As previously indicated, since current planning is based on the Siemens S70 Short vehicle, all other available cars fall within these parameters.

Vehicle Width

Modern streetcars operating in the United States have been designed and built with a car width of 8.1 feet or 8.7 feet (Siemens S70). The wider dimension has little effect on increasing capacity. The more significant benefit is that it allows two-and-two lateral seating in the passenger compartment versus a two-and-one arrangement. The effects of the car width must be considered with regard to infrastructure (e.g., station platform offset and clearance through curves along the right of way).

Vehicle Floor Height (Percent Low Floor)

Modern streetcars are built either with a low floor area between 50 and 70 percent of the length of the vehicle or are 100 percent low floor. The floor height in the low floor sections is approximately 14 inches above top of rail. See Figure 11 which shows differences in the extent of low floor sections in different vehicles.

The 50 to 70 percent low floor cars allow the car design to include a traditional truck configuration having solid axles connecting pairs of wheels and motors and gears in between the wheel pairs. The 100 percent low floor car designs require a special truck design incorporating motors and gears located on the truck frame outboard of the wheels. Wheels may be mounted individually on stub axles or with axle-connected pairs of wheels. Overall, the running gear is much more complicated than with traditional trucks.

The 50 to 70 percent low floor cars provide for easy boarding in the low floor area, but negotiating interior steps and being furthest from the doors generally discourages passenger circulation to the high floor areas. The S70 Short is designed with four doors per side, which provides for more space for passenger access and egress. Passengers not insistent on having a seat and traveling only a short distance tend to prefer to remain in the low floor area near the doors. For 100 percent low floor vehicles, mobility impaired access is limited to the area adjacent to the center sets of doors. General passenger access is available through the doors behind operator's cabs, but ADA circulation to the rest of the vehicle is restricted due to the narrow aiseways in the areas above the lower floor trucks.

Station Platform Configuration

Two approaches are being used to address vehicle accessibility in accordance with ADA requirements: the first uses bridgeplates to address the gap and the height difference between the vehicle floor (generally 14 inches) and a lower platform height (10 inches). Level boarding is accomplished when the vehicle floor height (14 inches) is the same elevation as a higher platform (also 14 inches), within allowable tolerances. All streetcars for New Starts projects since the Washington, D.C. procurement have been designed for level boarding.

Portland, the first modern streetcar system in the U.S. that opened in 2001, opted for use of bridgeplates since the approach applied to the regional light rail system serving that city. Tacoma, the second to open in 2003, followed suit. The station platforms are the same height as a typical sidewalk curb, generally between 8 and 10 inches. With the exception of the District of Columbia Department of Transportation (DDOT) streetcars, all of the early modern streetcars have been designed with vehicle borne bridgeplates that are deployed as a ramp to permit mobility impaired passengers to transition from the streetcar (14 inches above top of rail) to the station platform (8 to 10 inches above top of rail).

In 2016, DDOT, with the assistance of Washington Metropolitan Area Transit Authority (WMATA) at the time, was the first to require level boarding when the initial project was planned for implementation on abandoned railroad right-of-way in Anacostia. The DDOT alignment along H Street and Benning Road was the first modern system in the U.S. to be designed and built to provide for level boarding. The streetcars were built with a leveling system to match the floor height with the platform height. With the exception of newer streetcar lines in Seattle and expansion of the systems in Portland and Tacoma, all subsequent modern streetcar systems employ level boarding.

While DDOT built its platforms to provide a 14 inch height over a platform length corresponding to the distance between the doors in the low floor, level boarding area, subsequent systems have been built with level platforms equal to the full length of the vehicle. At present, Tampa is modeling its system using the Siemens S70 Short vehicle. If the station platform height is planned to be 14 inches above top of rail for the full length of the vehicle, all other candidate vehicles should be within this parameter. If the level station platform length is to be based upon the distance between the

doors in the low floor area, the platform configuration may change. Figure 11 illustrates this dimension among several vehicle types.

Off Wire Capability

Streetcar systems typically utilized overhead wire systems to provide power. However, it may not be desirable or feasible to install overhead wires in all locations and there are several reasons for considering the elimination of overhead contact wires (OCS). For instance, the presence of existing traffic signals and other utilities that would require relocation to accommodate the OCS, historic structures or districts, or the presence of mature trees that the community wants to retain. The City may have an additional reason for desiring a car with off wire capability, including crossovers with an existing railroad, at which an overhead wire may not be permitted.

A number of approaches for OCS have been developed or are in development, including:

- » Ground-level power systems (e.g., Bordeaux, France);
- » Onboard Energy Storage Systems (OES) (e.g., batteries, supercaps, flywheels); and
- » Onboard power supply (e.g., engine/generator).

The practical solution for Tampa may be an OES. The solution is relatively simple, and it is service proven. It is not proprietary, as in the case of the ground level systems, thereby permitting competition. The cost of implementation of a ground level system may be cost prohibitive for the Tampa streetcar system. Regardless, the costs associated with any extensions will then be limited to the original supplier to ensure compatibility of the system.

OES systems using batteries are in service in a number of U.S. cities, including Dallas, Detroit, Milwaukee, and Oklahoma City, and are planned for use in Charlotte and Tempe. Other OES systems that use supercaps or a combination of batteries and supercaps are being used around the world. The specific locations along the extension and existing alignment that would benefit from implementation of OCS operations requires further investigation, but the technology to integrate this element into the Tampa alignment exists and is service proven.

Expandability

The streetcars that are available to be procured by Tampa are designed and built to operate in three section articulated vehicles. For the present, this approach is adequate. At some time in the future, as ridership grows, Tampa may need to expand its fleet of vehicles and possibly the passenger capacity of vehicles. While Tampa may simply procure additional streetcars of the same or larger size, some carbuilders have designed vehicle platforms that are modular, which means they can assemble longer vehicles by adding additional carbody sections. For instance, the CAF vehicle, presently operating as a three-section vehicle in Cincinnati and Kansas City, may be expandable to five or more sections. Of course, the corresponding changes in infrastructure would have to be addressed. Figure 10 shows the three-section streetcar used for Cincinnati.

The Bombardier Flexity and Alstom Citadis are designed to be similarly expandable. Alstom originally provided 98-foot three-section Citadis streetcars to Dublin in 2004. In 2007, as ridership increased and the system expanded, they added two sections to these vehicles, increasing their length to 131 feet. Alstom also supplied new 131-foot-long five-section streetcars. In 2009, they delivered a fleet of 141 feet seven-section cars, and their most recent cars are nine-section vehicles 180 feet long. Due to inability to meet certain commercial contract terms, Alstom has been quiet in the U.S. marketplace. They have been replaced by the likes of Brookville Equipment Corporation, CAF, and Siemens.

Figure 10. CAF Urbos 3 Three Section Vehicle (Cincinnati)



Figure 11. Distance between Forward-most and Rear-most Door Openings in Low Floor Areas

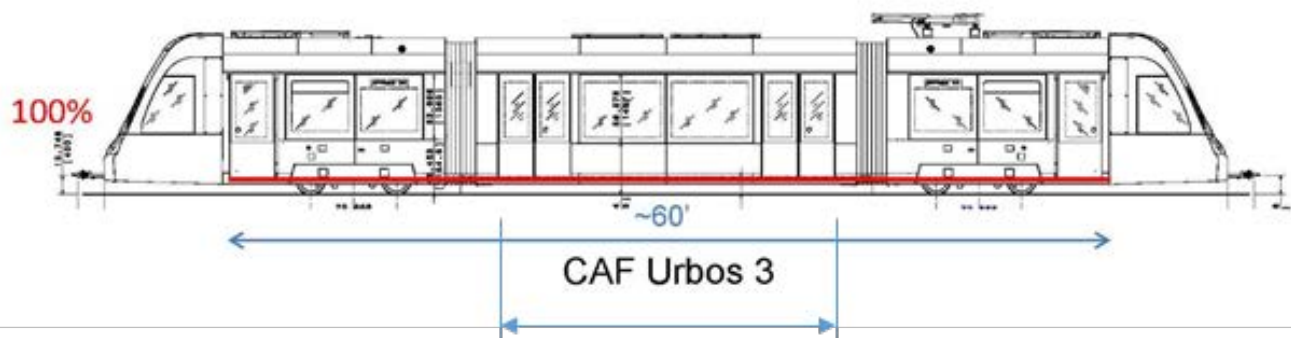
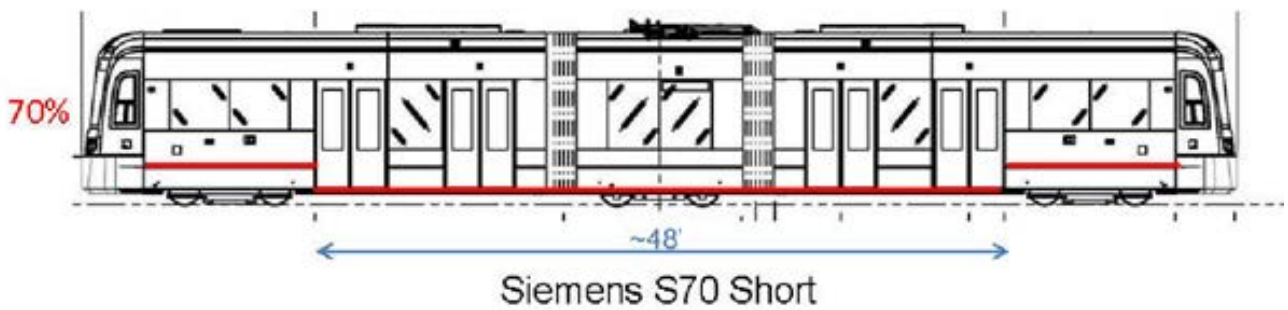
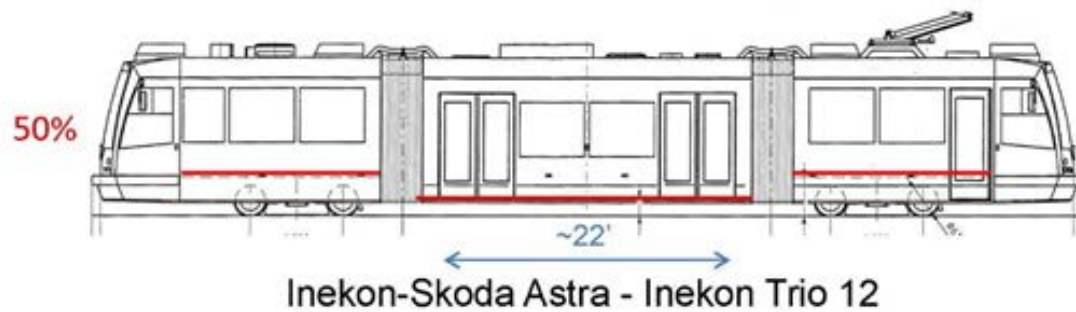
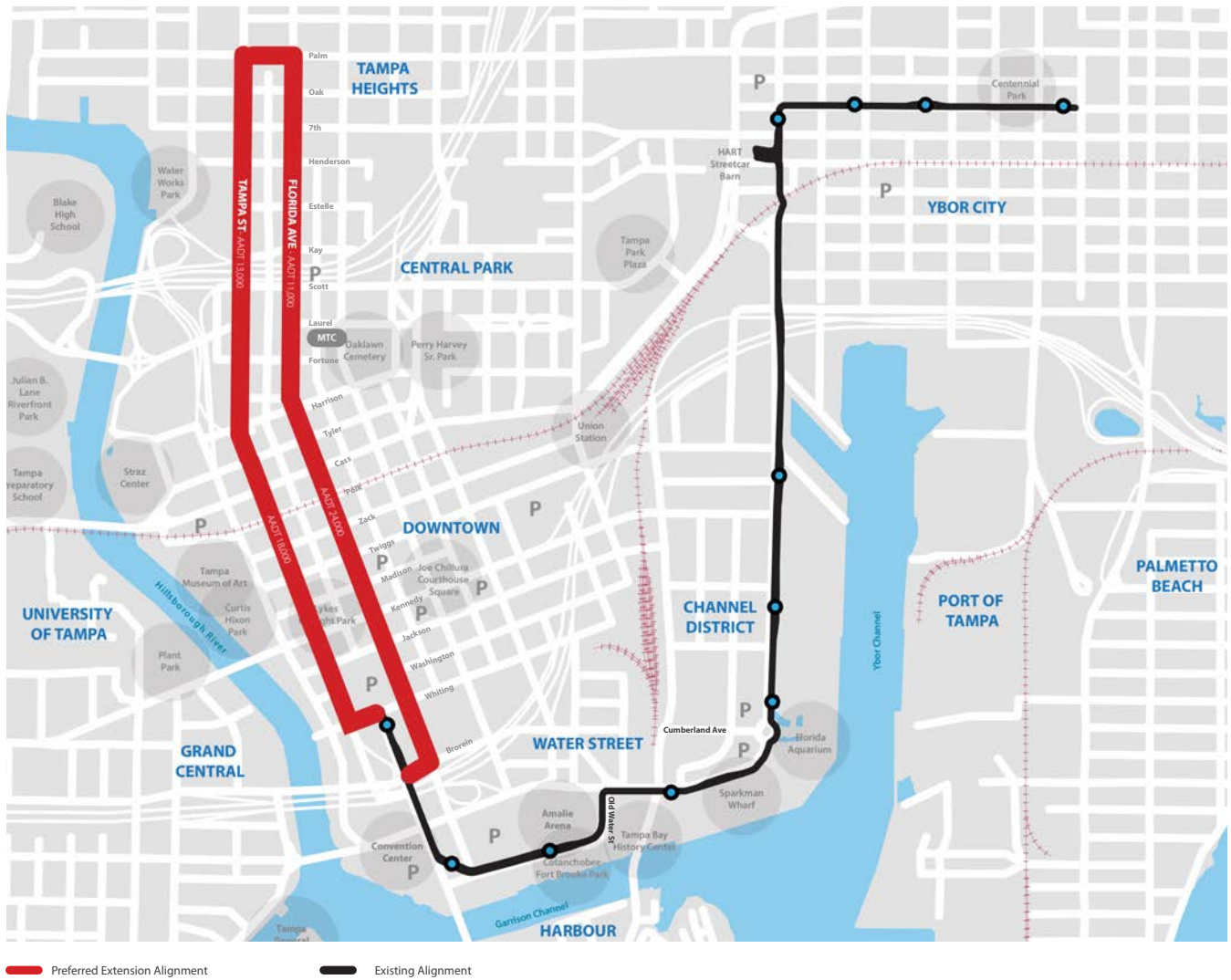


Figure 12. Preferred Extension Alignment



4.3 Extension Alignment & Guideway

Following the selection of extension alignment Options A (N/S Franklin Street) and B (N/S Tampa Street-Florida Avenue Couplet), a secondary evaluation was conducted to identify a preferred alignment and guideway configuration. The alignment and guideway alternative process, undertaken in the Summer and Fall of 2018, explored various alignment alternatives and guideway configurations and combinations along the Tampa Street, Franklin Street, and Florida Avenue corridors.

The evaluation took into account a wide range of impact, performance, and costs factors, as well as feedback from key stakeholders, including local property owners, residents, elected officials and agency representatives, and project partners FDOT and HART. Results of the evaluation were reviewed with project partners and elected officials in Fall 2018 work sessions, and with agency representatives and the general public during December 2018 workshops.

ALIGNMENT & GUIDEWAY SEGMENTS ALTERNATIVES

To support the alignment and guideway evaluation, six individual alignment segments were defined:

- » Florida Avenue from Brorein Street to Harrison Street;
- » Florida Avenue from Harrison Street to Palm Avenue;
- » Tampa Street from Palm Avenue to Tyler Street;
- » Tampa Street from Tyler Street to Kennedy Boulevard;
- » Tampa Street from Kennedy Boulevard to Whiting Street; and
- » Franklin Street from Tyler Street to Palm Avenue.

Guideway alternatives were prepared for each segment. Alternative typical sections were defined for each segment showing possible exclusive and shared guideway configurations along the Tampa Street, Franklin Street, and Florida Avenue corridors.

ALIGNMENT & GUIDEWAY DECISION FACTORS

Guideway alternatives for each segment were evaluated using the following four decision factors addressing performance benefits and impacts:

- » **Transit Travel Time Reliability.** This decision factor evaluated potential travel time impacts of various guideway configurations on traffic congestion,

turning movements, and on-street parking and loading. Alternatives with exclusive transit lane operations received high scores while those providing operations in mixed travel lanes received lower scores. Exclusive transit lane operations provide for greater transit travel time reliability. They allow transit vehicles operating in barrier-separated lanes to bypass traffic and turning lane congestion, and avoid potential impacts to transit operations associated with poorly parked and double-parked cars and delivery vehicles.

- » **Traffic, Bike Lane, & Parking Impacts.** This decision factor assessed each segment's guideway alternatives based on impacts to existing vehicle traffic capacity and traffic operations, property and alley access, bike travel lanes, and on-street parking. Alignments and guideways with the fewest impacts scored high, and those with multiple impacts scored low. Although exclusive transit lane alternatives not requiring removal of travel lanes performed well under this category, these alternatives also resulted in the loss of on-street parking and would require relocation of bike lanes to parallel corridors.
- » **Shared Transit Use.** Each alignment and guideway option was scored based on its ability to support potential shared use with local buses or other rubber tire vehicle technology. Segments that allowed for right-hand stops performed best, as these stops allow use by conventional bus types.
- » **Right-of-Way & Street Reconstruction.** Alignment and guideway options not requiring additional right-of-way to accommodate lane configurations and stop locations scored highest under this factor.

Results of the evaluation scoring process, including the overall evaluation matrix, are included in Appendix A - Alignment Evaluation Process.

PREFERRED EXTENSION ALIGNMENT

The evaluation of segment alternatives resulted in the selection of an extension traveling 1.2 miles north from Downtown to Palm Avenue as a north/south couplet paring Florida Avenue and Tampa Street (see Figure 12). The preferred extension alignment begins near the existing streetcar terminus at Whiting Street and Franklin Street. From the existing track on Franklin Street, the northbound track extension turns east at Brorein Street, then turns north at Florida Avenue to extend through the Downtown Core and Tampa Heights to Palm Avenue. At Palm Avenue, the alignment turns west and travels two blocks before turning south onto

Tampa Street. The southbound alignment runs along Tampa Street to Whiting Street. At Whiting Street, the alignment turns east to link back to the existing downtown streetcar terminus at the Whiting Street Station.

PREFERRED EXTENSION GUIDEWAY

A detailed segment-by-segment description of the guideway along the preferred extension alignment is provided below. Detailed guideway exhibits by segment are included in Appendix B - Preferred Extension Guideway & Stops.

- » **Segment 1: Florida Avenue from Brorein Street to Harrison Street.** As shown in Figure 13, Segment 1 of the preferred alignment runs on Florida Avenue from Brorein Street to Harrison Street. The guideway begins near the existing downtown streetcar terminus at Whiting Street and Franklin Street. From the existing track traveling north on Franklin Street, the guideway turns east at Brorein Street then turns north at Florida Avenue. On Florida Avenue, the guideway is an exclusive transit lane on the west side of the street. East-side parking along this segment would be removed to maintain three travel lanes. Existing parking on the west side of the street would be moved to run outboard of the exclusive transit lane. This allows for right-side transit stops in the west-side parking lane. Left turns to Kennedy Boulevard and Cass Street would displace the west-side parking. At the Tyler Street intersection, the guideway switches from the west side of Florida Avenue to the east side of the street where it will run in a shared travel lane. The existing bike lane on Florida Avenue will be replaced by a bike boulevard along Franklin Street.
- » **Segment 2: Florida Avenue from Harrison Street to Palm Avenue.** As shown in Figure 14, Segment 2 of the preferred alignment on Florida Avenue runs from Harrison Street to Palm Avenue. The alignment then turns west and travels two blocks on Palm Avenue. Because of the reduced right-of-way width, in this segment the guideway will be in a shared travel lane on the east side of the street. This maintains three travel lanes along this segment and allows for a right-side stop close to the Marion Transit Center. The existing bike lane on Florida Avenue will be replaced by a bike boulevard along Franklin Street.
- » **Segment 3: Tampa Street from Palm Avenue to Tyler Street.** As shown in Figure 15, Segment 3 runs along Tampa Street from Palm Avenue to Tyler Street. The guideway in this segment is an exclusive transit lane on the east side of the street. West-side parking along this segment would be removed to maintain three travel lanes. Right-side stops would be located in an extended buffer to the west side of the exclusive transit lane. Existing travel lanes will remain and shift to accommodate these stop locations. The existing bike lane on Tampa Street will be replaced by a bike boulevard on Franklin Street.
- » **Segment 4: Tampa Street from Tyler Street to Kennedy Boulevard.** As shown in Figure 16, Segment 4 of the preferred alignment runs along Tampa Street from Tyler Street to Kennedy Boulevard. The guideway in this segment is an exclusive transit lane on the east side of the street. West-side parking along this segment would be removed to keep the existing three travel lanes for cars. Existing parking on the east side of the street would be moved to run outboard of the new transit lane. This allows for right-side transit stops in this parking lane. The existing bike lane on Tampa Street will be replaced by a bike boulevard on Franklin Street.
- » **Segment 5: Tampa Street from Kennedy Boulevard to Whiting Street.** As shown in Figure 17, Segment 5 of the preferred alignment runs on Tampa Street from Kennedy Boulevard to Whiting Street. At Whiting Street, the alignment turns east to link back to the existing downtown streetcar terminus at the Whiting Street Station. The guideway in this segment is in a shared travel lane on the east side of the street, outboard of the existing east-side parking. This maintains three travel lanes, partially avoids left turn queuing at Jackson Street, and avoids the passenger drop-off and valet service at the Hilton hotel. No stops are planned for this segment. The existing bike lane on Tampa will be replaced by a bike boulevard on Franklin Street.

Figure 13. Segment 1: Florida Avenue from Brorein Street to Harrison Street

SEGMENT LOCATION



EXISTING CONDITIONS

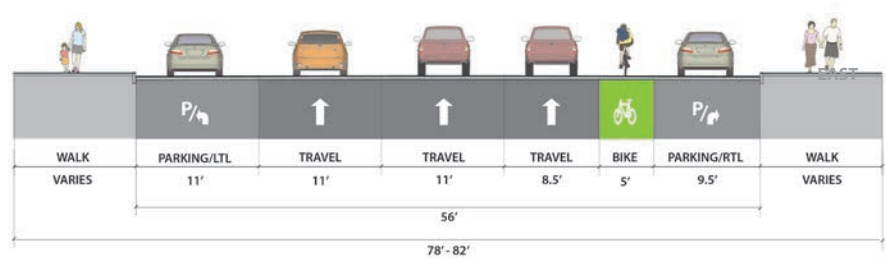


Looking North on Florida Avenue at Kennedy Boulevard



Looking North on Florida Avenue at Cass Street

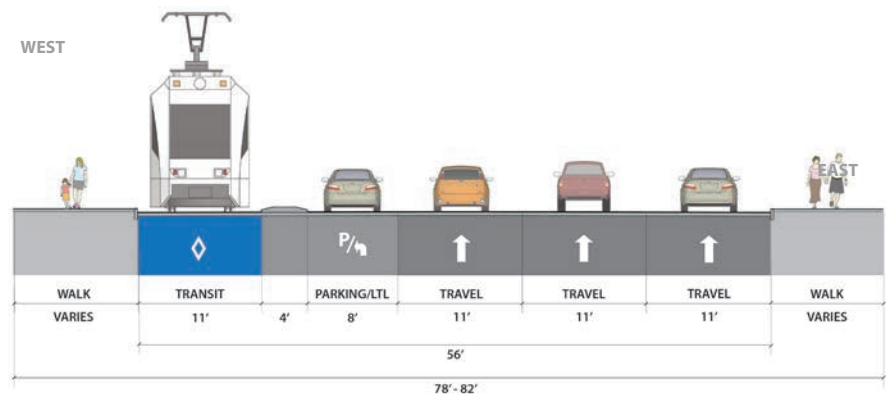
WEST



RECOMMENDED EXTENSION GUIDEWAY

West Side Running in Exclusive Transit Lane

WEST



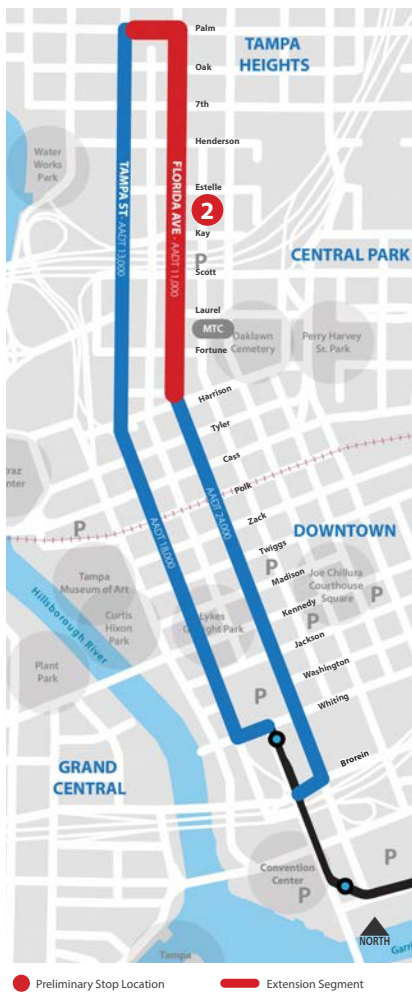
HIGHLIGHTS

- » The Segment 1 guideway is primarily an exclusive transit lane on the west side of Florida Avenue.
- » East-side parking would be removed to maintain three travel lanes.
- » Existing parking on the west side of the street would be moved to run outboard of the exclusive transit lane.

- » Right-side stops would be located in the west-side parking lane.
- » Left turns to Kennedy Boulevard and Cass Street would displace the west-side parking.
- » At Tyler Street, the guideway switches from the west side of Florida Avenue to the east side of the street where it will run in a shared travel lane.

Figure 14. Segment 2: Florida Avenue from Harrison Street to Palm Avenue

SEGMENT LOCATION



HIGHLIGHTS:

- » Segment 2 runs from Harrison Street to Palm Avenue on the east side of Florida Avenue in a shared travel lane because of reduce right-of-way along this segment.
- » Right-side stops would be located in the sidewalk.
- » Maintains three travel lanes.
- » Allows for a right-side stop close to the Marion Transit Center.
- » The alignment turns west at Palm Avenue and travels two blocks.

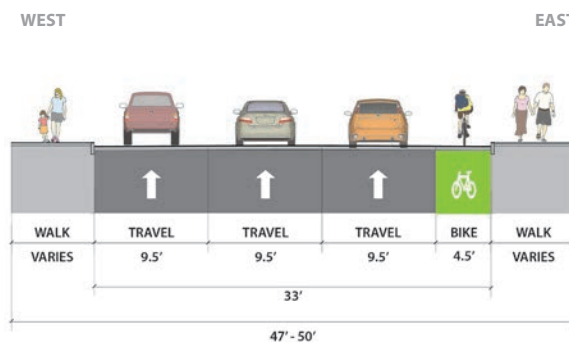
EXISTING CONDITIONS



Looking North on Florida Avenue at Kay Street



Looking North on Florida Avenue at Henderson Avenue



RECOMMENDED EXTENSION GUIDEWAY

East Side Running in Shared Lane

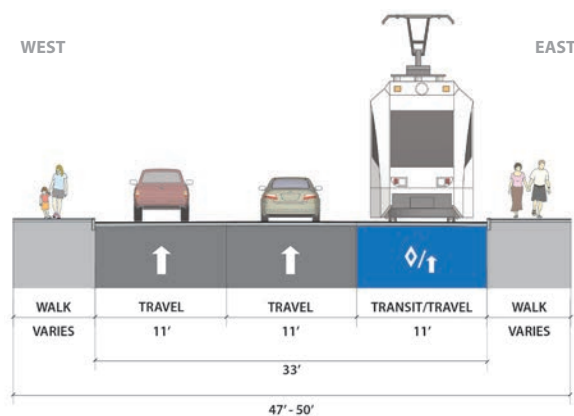


Figure 15. Segment 3: Tampa Street from Palm Avenue to Tyler Street

SEGMENT LOCATION



HIGHLIGHTS:

- » Segment 3 runs along Tampa Street from Palm Avenue to Tyler Street in an exclusive transit lane on the east side of the street.
- » West-side parking would be removed to maintain three travel lanes.
- » Right-side stops would be located in an extended buffer to the west of the exclusive transit lane.
- » Existing travel lanes will remain and shift to accommodate these stop locations.

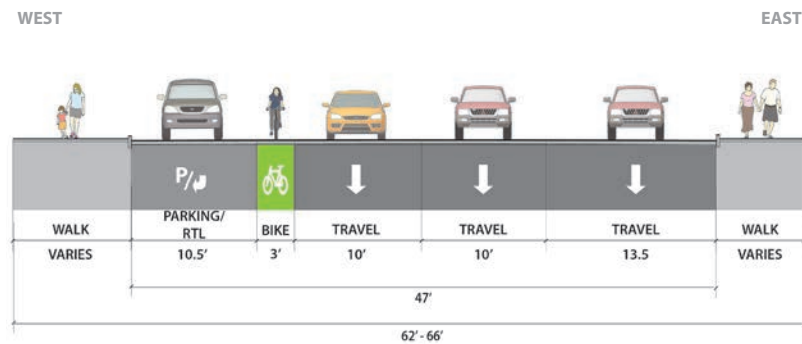
EXISTING CONDITIONS



Looking North on Tampa Street at Harrison Street



Looking North on Tampa Street at Laurel Street



RECOMMENDED EXTENSION GUIDEWAY

East Side Running in Exclusive Transit Lane

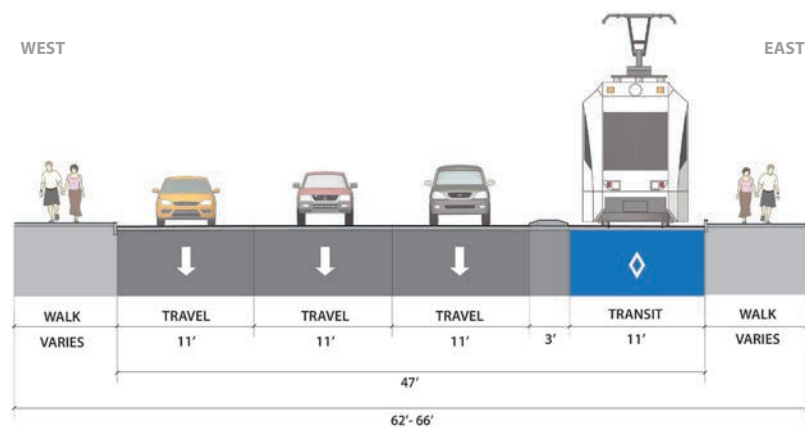


Figure 16. Segment 4: Tampa Street from Tyler Street to Kennedy Boulevard

SEGMENT LOCATION



HIGHLIGHTS:

- » Segment 4 runs along Tampa Street from Tyler Street to Kennedy Boulevard in an exclusive transit lane on the east side of the street.
- » West-side parking would be removed to keep existing three travel lanes.
- » Existing parking on the east side of the street would be moved to run outboard of the new transit lane.
- » Right-side stops would be located in the west-side parking lane.

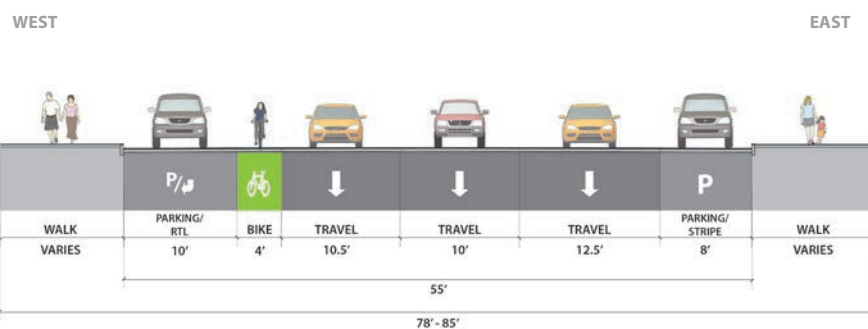
EXISTING CONDITIONS



Looking North on Tampa Street at Kennedy Boulevard.



Looking North on Tampa Street at Polk Street



RECOMMENDED EXTENSION GUIDEWAY

East Side Running in Exclusive Transit Lane

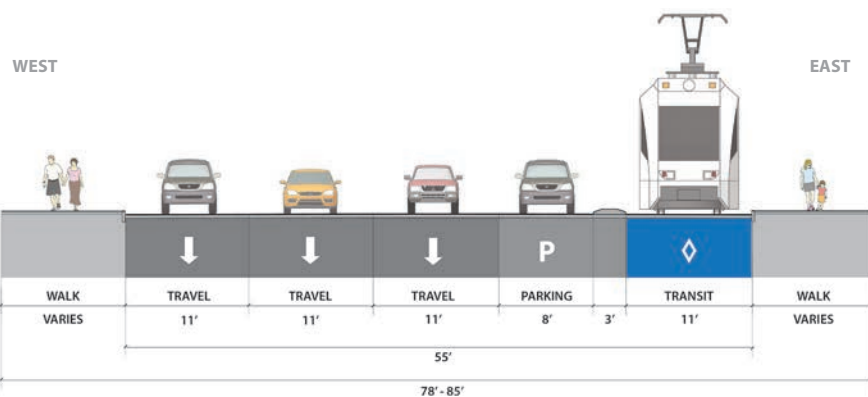


Figure 17. Segment 5: Tampa Street - from Kennedy Boulevard to Whiting Street

SEGMENT LOCATION



HIGHLIGHTS:

- » Segment 5 runs on Tampa Street from Kennedy Boulevard to Whiting Street in a shared travel lane outboard of existing east-side parking.
- » Maintains three travel lanes.
- » Partially avoids left turn queuing at Jackson Street, and avoids the passenger drop-off and valet service at the Hilton hotel.
- » At Whiting Street, the alignment turns east to link back to the existing Whiting Street Station.
- » No stops are planned for this segment.

EXISTING CONDITIONS



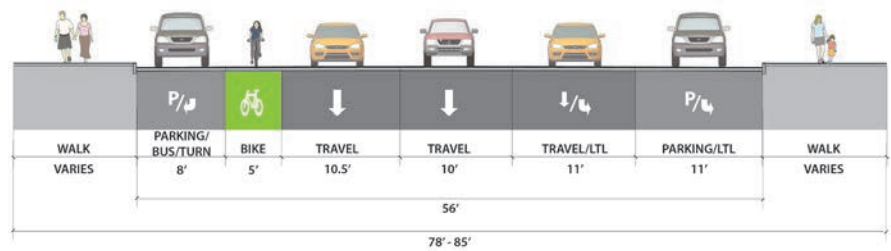
Looking North on Tampa Street at Jackson Street



Looking North on Tampa Street at the Hilton just south of Jackson Street

WEST

EAST

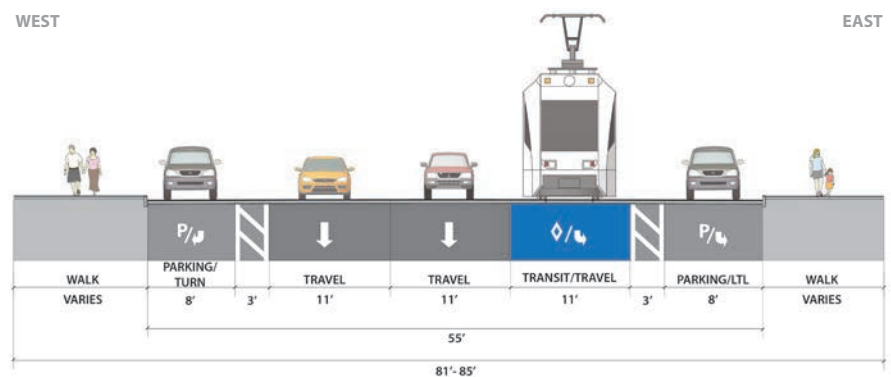


PREFERRED EXTENSION GUIDEWAY

East Side Running in Shared Lane

WEST

EAST



TYPICAL TRACK SECTION

The proposed expansion of the streetcar system will utilize an embedded track section as shown in Figure 18. The 8-foot-wide track slab thickness will be installed within the existing pavement section where existing profile and transverse grades can be accommodated. A variable width transition area adjacent to the track slab will be utilized to minimize impacts on existing pavement sections. A 4 foot-8½ inch standard track gauge will be maintained through the track expansion. A 14 inch track slab thickness is shown with a single mat of reinforcing steel; however, the design will need to be verified with existing soil conditions and pavement design. Single 115 RE Tee Rail is shown with a rubber boot surround and flangeway for stray current isolation. In curves with radii of less than 400 feet, a second restraining rail will be provided. Depending on communications and traction power requirements to be determined in later design, embedded conduit within the track slab or duct bank below the track slab may be required.

112 TRAM Block Rail Alternative Track Slab

An alternative to standard 115 RE Tee Rail is 112 TRAM Block Rail. This rail has been successfully used on a number of modern streetcar projects in Dallas, Kansas City, Seattle, and Orange County, CA. The domestically produced, Buy American compliant block rail has the following benefits over tee rail:

- » Low profile rail section (3 inches tall verse 7 inches typical of tee rail) provides design flexibility and reduces subsurface conflicts with shallow utilities and bridge decks.
- » Narrow flangeway reduces the gap that narrow-tired vehicles such as wheelchairs, mopeds, and bicycles need to traverse and reduces the likelihood of a tire getting caught in the flangeway. This is an issue for embedded track independent of the rail type. Block rail allows for a 1½ inch flangeway which is less than the 2¼ inch gap that is typically achieved with tee rail because of construction and maintenance issues that accompany a non-steel flangeway.
- » The durable steel flangeway does not spall like concrete or puncture like rubber. It minimizes the potential of longer term issues and greater hazards in the roadway such as damaged flangeway widths far in excess of the typical 2¼ inch gap that was installed/constructed.

- » Three sides of the rail are wrapped in a rubber boot which mitigates the affects of stray current and dampens the noise and vibration levels.
- » Allows for a thinner track slab (2 inches or more) where soil conditions and slab design permit it. That can result in decreased slab costs and utility conflicts.
- » Lower future flangeway maintenance costs as opposed to formed rubber flangeways that deteriorate over time.

Disadvantages include:

- » Increased cost per foot of block rail due to higher manufacturing costs and increased number of welded joints.
- » Costs for transition rails between tee rail in the existing system and at special trackwork utilizing tee rail (block rail currently not used in domestic special trackwork).
- » More complicated designs for insulated joints, track flangeway drainage, and restraint in tighter curves.

Figure 19 provides an example of a typical block rail installation.

Figure 18. Typical Section - Embedded Track Slab

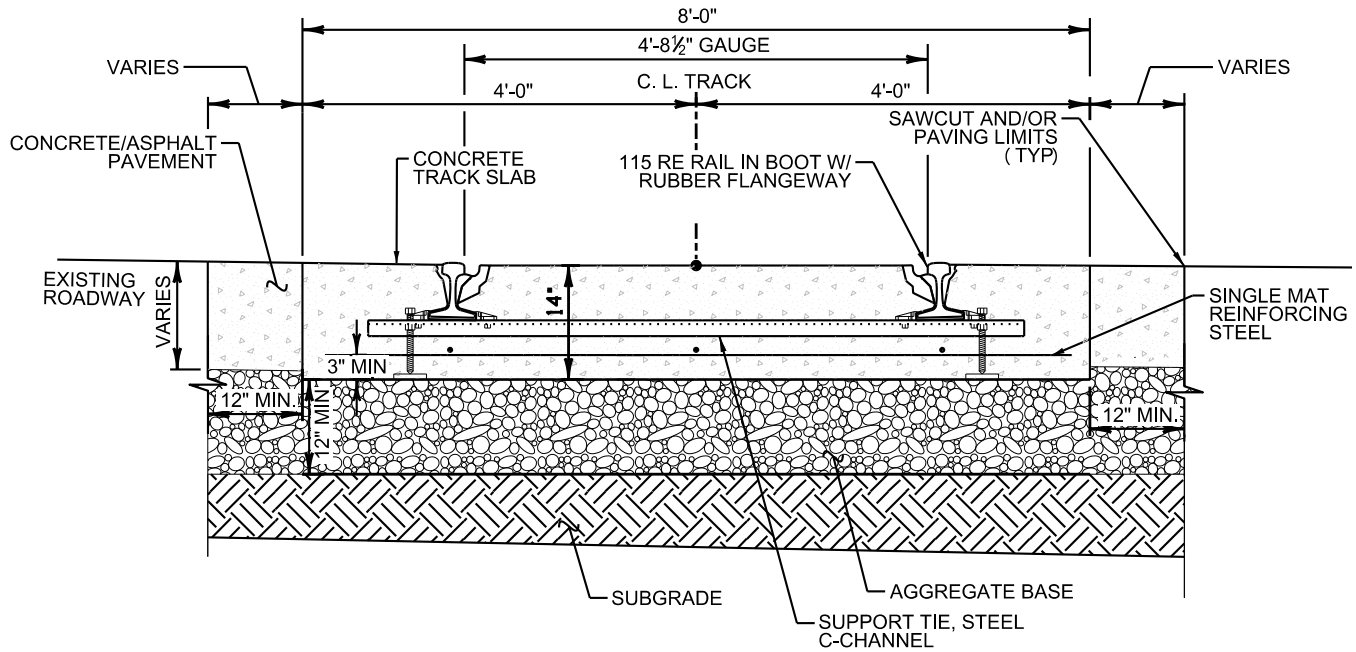
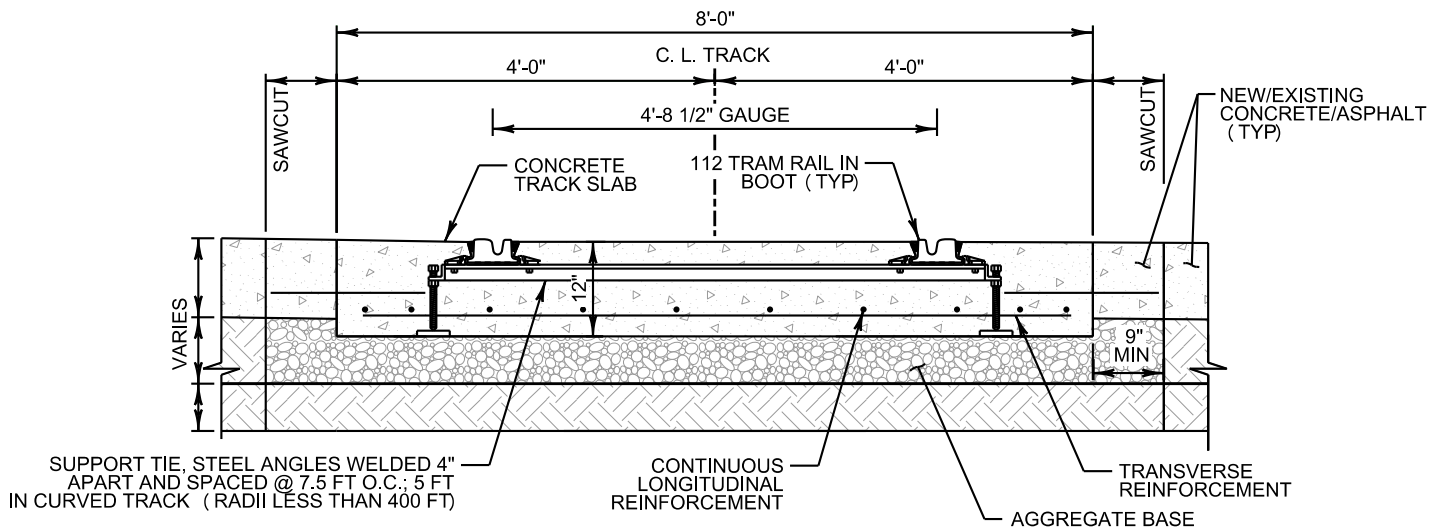


Figure 19. Typical Section – 112 TRAM Rail Track Slab



4.4 Existing Guideway Modification

As shown in Figure 20, four locations along the existing streetcar guideway will require reconstruction to accommodate the larger turning radius of a modern streetcar vehicle. Starting at the northern end of the existing guideway, the four locations are:

- » Near Jose Marti Park in Ybor City.
- » South of East 5th Street near the intersection of the streetcar and CSX tracks.
- » Near East Cumberland Avenue at the roundabout in the Channel District.
- » The intersection of Channelside Drive and Old Water Street near the Tampa Bay History Center and Amelia Arena.

Detailed concept drawings of these turn locations can be found in Appendix C - Existing Guideway Modifications.

4.5 Stop Concepts & Locations

STOP DESIGN CONCEPTS

To accommodate modern streetcar vehicles and allow for shared use by other transit vehicle types, stops along the extension will be designed with a 14-inch-high platform section for level, ADA-compliant streetcar boarding and a lower, 8-inch-high platform section for bus boarding. Along the existing streetcar line, stops will be retrofitted to provide a 14-inch high platform section for level, ADA-compliant streetcar boarding.

The overall footprint of stops will be similar in scale to stops on the existing line, and measure approximately 10-feet-wide by 100-feet-long. New and retrofitted stops will have similar amenities, which could include:

- » canopy/covered area;
- » seating, railings, trash receptacles;
- » system information map, kiosk, signage;
- » dynamic message sign, public address speaker;
- » ticket vending machine;
- » lighting and security elements; and
- » ADA-compliant access and ramps.

NEW STOPS ALONG EXTENSION

For stops along the extension, one of two stop types will be constructed. As shown in Figures 22 and 23, one type will be positioned in the parking lane to the right of the guideway. The other type will be positioned along existing sidewalks adjacent the guideway. The type of stop depends on the guideway location in the street. Refer to Table 4 for information regarding stop type.

PREFERRED EXTENSION STOP LOCATIONS

Stops for the streetcar extension will be located every four to five blocks and within easy walking distance of nearby destinations. Figure 20 and Table 4 lists the preferred extension stop locations and types. More detailed proposed stop locations can be found in Appendix B - Preferred Extension Guideway & Stops.

MODIFICATION OF EXISTING STOPS

Each of the 11 stops along the existing streetcar line will be retrofitted to accommodate modern streetcar vehicles.

While most existing stops have many of the proposed amenities listed above, they also include a highblock boarding platform, accessed by a ramp, designed to provide wheelchair access via an ADA bridge to the higher interior floor of the replica streetcar vehicles. The existing highblock boarding platforms are 26 inches high.

The highblocks, ramps, and central sections of the existing stops will be removed, and a new 14-inch high platform will be constructed. Existing shelters and other equipment and amenities will be removed and reinstalled or replaced in-kind. Future design phases will determine if the new concrete platform will be constructed around the existing columns or if the shelters will be removed and installed on the new platform or replaced in-kind.

At all existing stops, the construction of new platforms will require removal of the existing concrete sidewalks, curb, and platforms, so the new platform and ramps may be constructed.

All new construction activity required to modify the existing stops will occur within the existing footprint of the stops.

Figure 20. Preferred Extension Alignment with Proposed Stop Locations and Modernization Projects

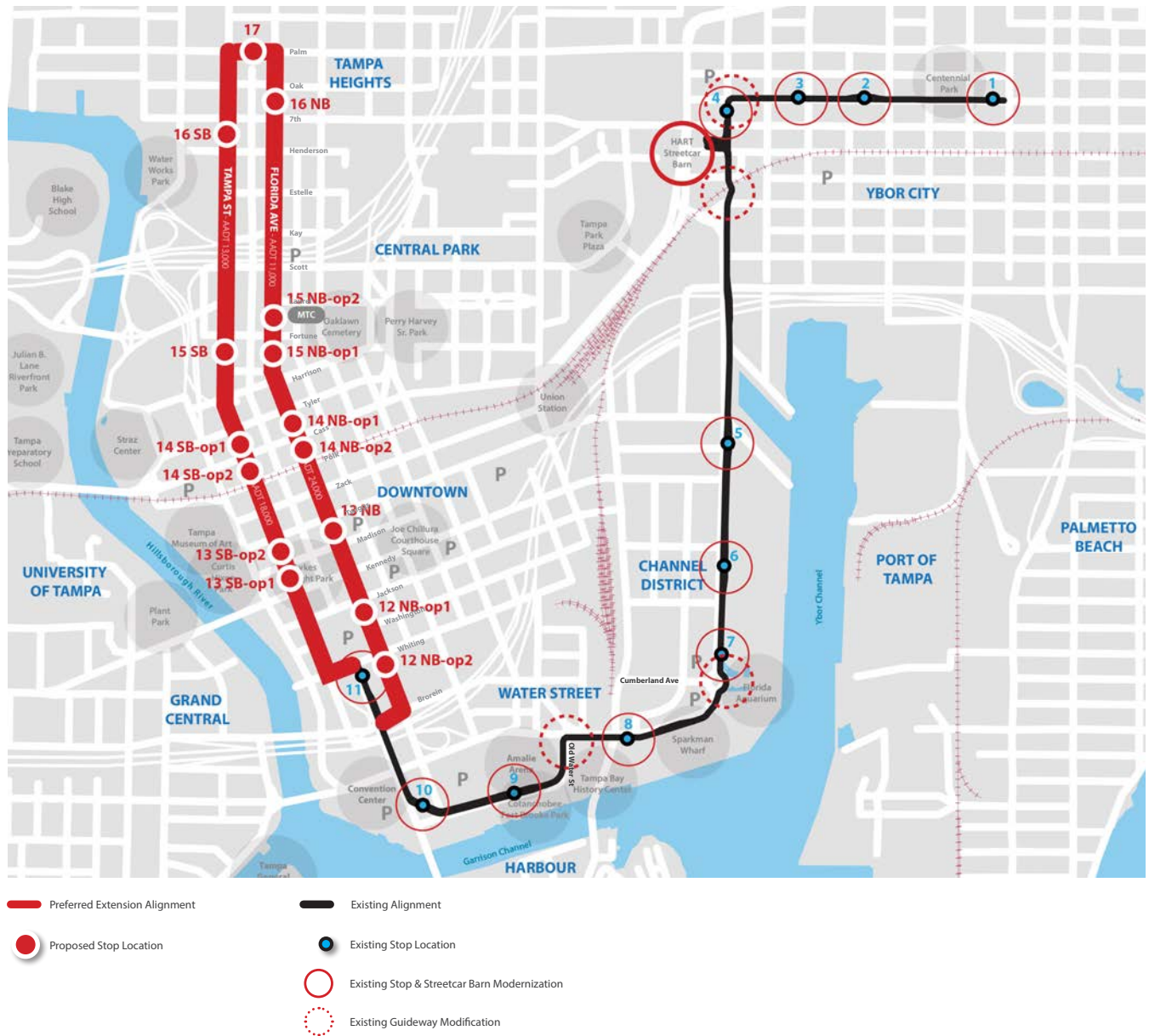


Table 4. Preferred Extension Stop Locations & Stop Types

Stop Number & Direction	Stop Location	Segment	Stop Type
FLORIDA AVENUE			
12 NB (option 1) 12 NB (option 2)	Jackson Street Whiting Street	1	right-side in island/parking lane
13 NB	Madison Street	1	right-side in island/parking lane
14 NB (option 1) 14 NB (option 2)	Cass Street Polk Street	1	right-side in island/parking lane
15 NB (option 1) 15 NB (option 2)	Fortune Street Laurel Street	2	right-side in sidewalk (ROW required)
16 NB	7th Avenue	2	right-side in sidewalk (ROW required)
PALM AVENUE			
17	Palm Avenue	2	right-side in sidewalk (ROW required)
TAMPA STREET			
16 SB	7th Avenue	3	right-side in island/parking lane
15 SB	Fortune Street	3	right-side in island/parking lane (ROW required)
14 SB (option 1) 14 SB (option 2)	Cass Street Polk Street	4	right-side in island/parking lane lane
13 SB	Madison Street	4	right-side in island/parking lane lane

Figure 21. Example Stops in Kansas City, Missouri; Portland, Oregon; and Seattle, Washington



Figure 22. Right side stop on sidewalk as proposed for guideway segment 2

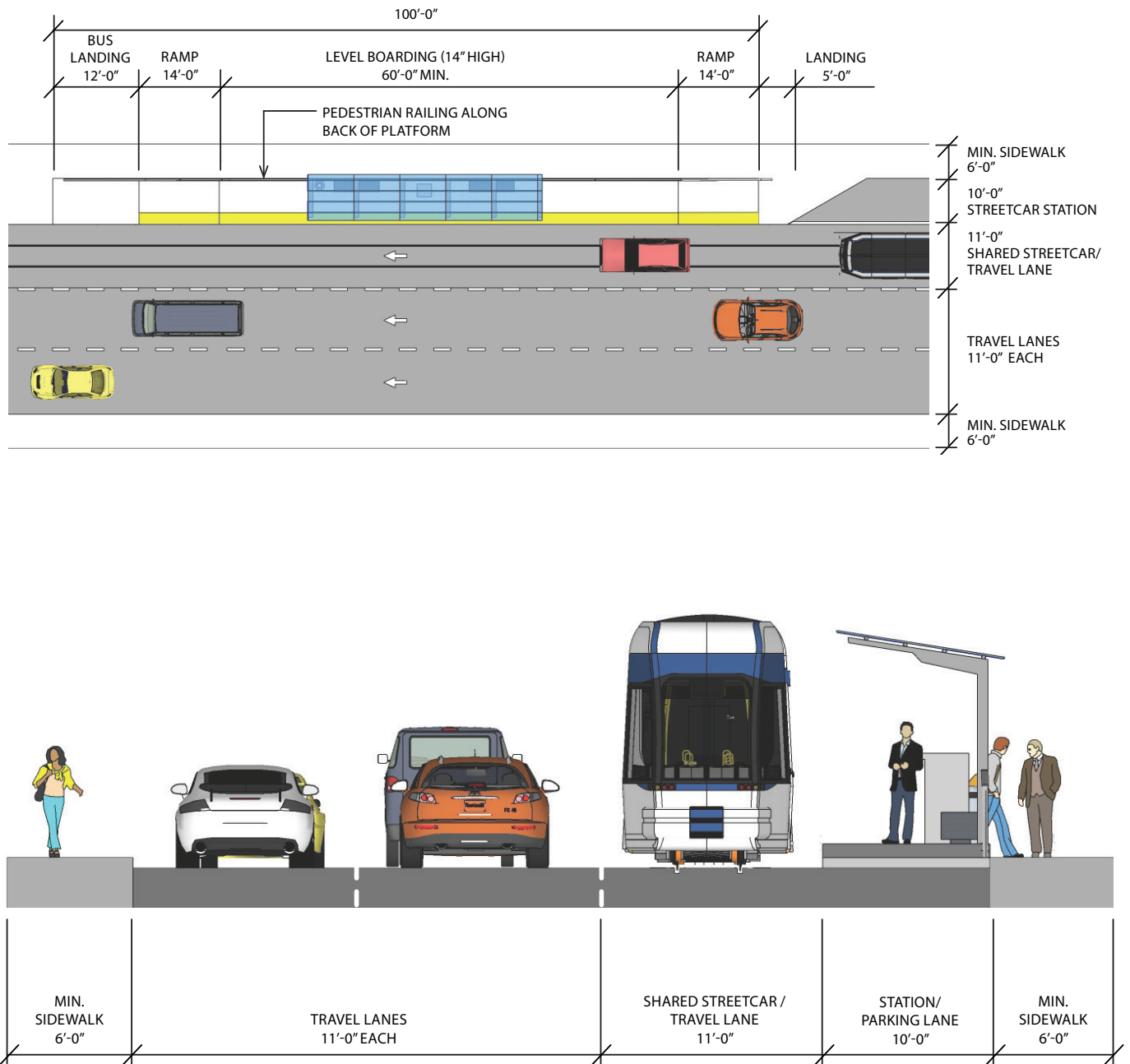
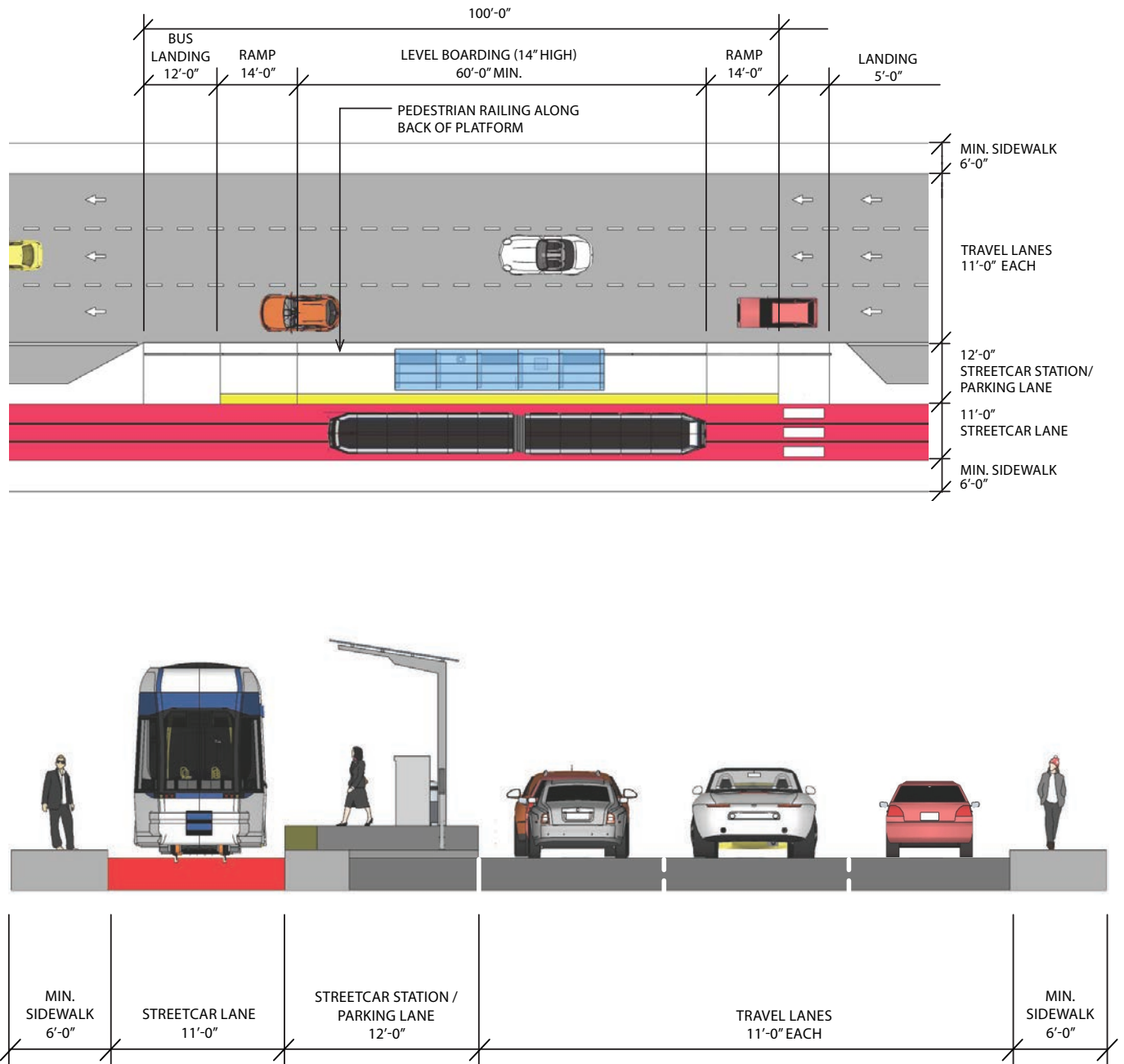


Figure 23. Right side stop in island/parking lane as proposed for guideway segments 1, 3, and 4



4.6 Vehicle Maintenance Facility Concepts

An evaluation of the existing streetcar vehicle maintenance facility (VMF) in Ybor City was conducted to determine the feasibility of modifying or expanding the facility to accommodate new vehicles. For the purposes of the evaluation, it was assumed that eight new modern streetcar vehicles and three existing replica historic vehicles will need to be maintained and stored on site along with related service and maintenance equipment. This section of the report provides a review of the evaluation process and findings from initial conceptual planning effort.

EXISTING FACILITY EVALUATION

An on-site evaluation of the existing VMF and site was conducted on November 6, 2018. The initial findings of the evaluation are organized around the following functional categories:

- » Office and Staff Support (first and second level);
- » Parts and Material Storage;
- » Service and Inspection Position (S&I);
- » Heavy Repair Position;
- » Wheel Truing;
- » Mezzanine Level Component Shops and Staging;
- » Cleaning and Sanding (streetcar interior and exterior cleaning);
- » Streetcar Storage; and
- » Other Exterior Storage.

The findings are documented in the *VMF Evaluation Technical Memorandum*. [Memo to be finalized and made available for posting on project web site.]

VEHICLE SPECIFICATIONS FOR CONCEPTUAL PLANNING

For conceptual planning purposes to evaluate VMF requirements, the study team used specifications for the Siemens S70 Short vehicle, which is one of the larger vehicles currently available. Use of the S70 specifications for this evaluation and conceptual planning effort allows for future flexibility in selection of the S70 vehicle or a vehicle from another supplier. Final vehicle selection will occur during the engineering phase of the project.

The Siemens S70 Short streetcar is a low floor type modern streetcar. The S70 is a modern triple articulated streetcar with all three sections being low floor for easy boarding. For the purposes of the study, it was assumed

that eight new vehicles would be required to provide service along the existing system and the extension to Tampa Heights. Additionally, three existing replica historic vehicles would be retained for future use.

CONCEPTUAL PLANS

To accommodate the Siemens S70 Short, significant modifications to the existing facility and yard will be required. Vehicle length is substantially longer than the existing vehicles. The S70 is 82 feet in length. They also have a different roof access height, are narrower, have a greater turning radius, and have a 70 percent low floor design, which requires a different motor truck design and a different arrangement of components on the car than the existing vehicles. Differences in component locations will require reconstruction of the maintenance bays to provide for a lower level work area with a "wide pit" design, and the difference in turning radius will require significant reconstruction of tracks in the yard to the immediate west of the existing VMF.

The planning team developed three conceptual plan alternatives illustrating options to meet maintenance, storage, and access requirements for eight new modern streetcar vehicles plus the three existing historic replica vehicles. The conceptual plan alternatives, all of which are constrained to the limits of the current site of the existing VMF and yard, required modifications to the existing maintenance bays, a westward expansion of the building to accommodate larger vehicles, the construction of a canopy or cover for outdoor storage of vehicles, and reconstruction of the track and yard to support larger vehicle turning radii.

A description of each conceptual plan follows, along with preliminary sketches showing the extent of required modifications per alternative.

Conceptual Plan 1

Conceptual Plan 1 (Figure 25) has the least amount of impact on the current VMF and its operations, as the expansion would only effect the north side of the current building. The first level will have a properly sized service and inspection (S/I) bay, flat bay, parts room, truck shop, and storage space. This concept is also relocating the "front door" of the facility to the northwest corner of the building, near the corner of 7th Avenue and Nuccio Parkway. This would be the main entry for visitors and would have a staircase and elevator to the third level HART administration offices. There is a canopy in front of the bays large enough for

Figure 24. VMF Existing Conditions (image taken March 4, 2018)

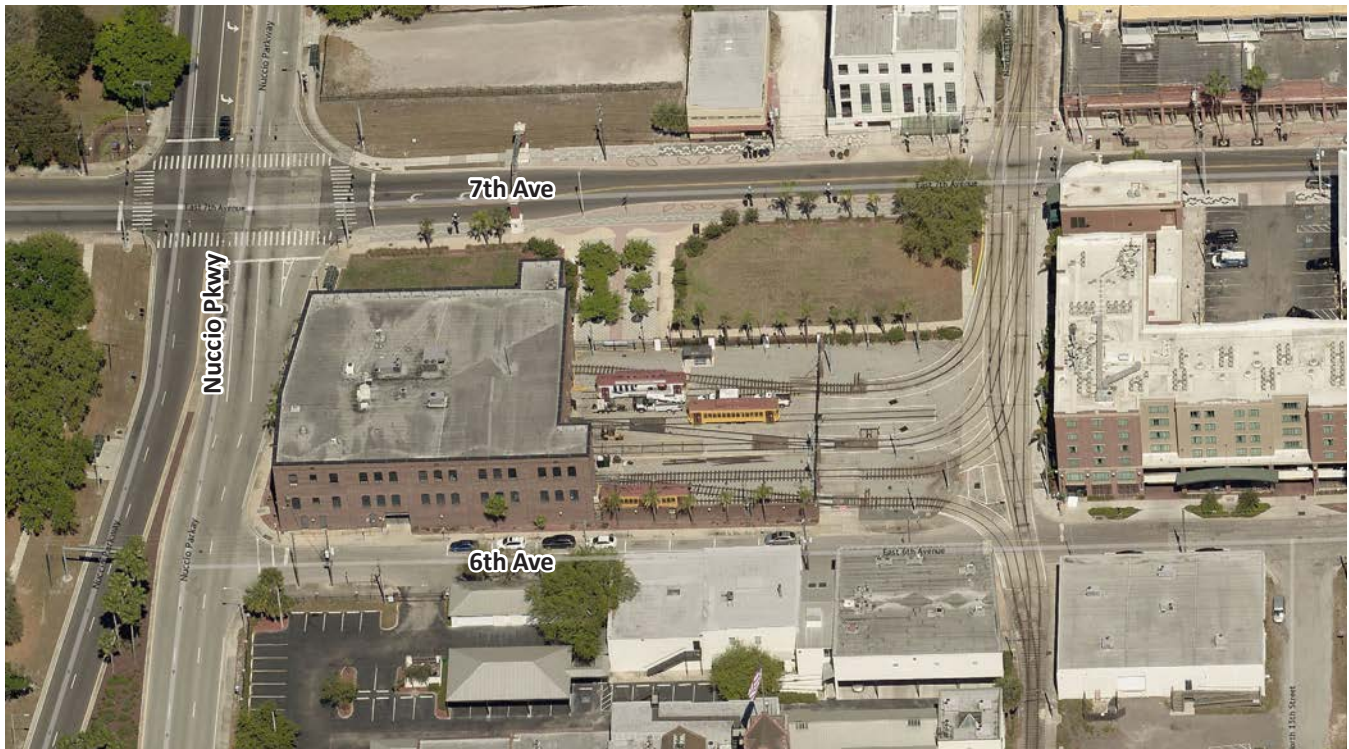
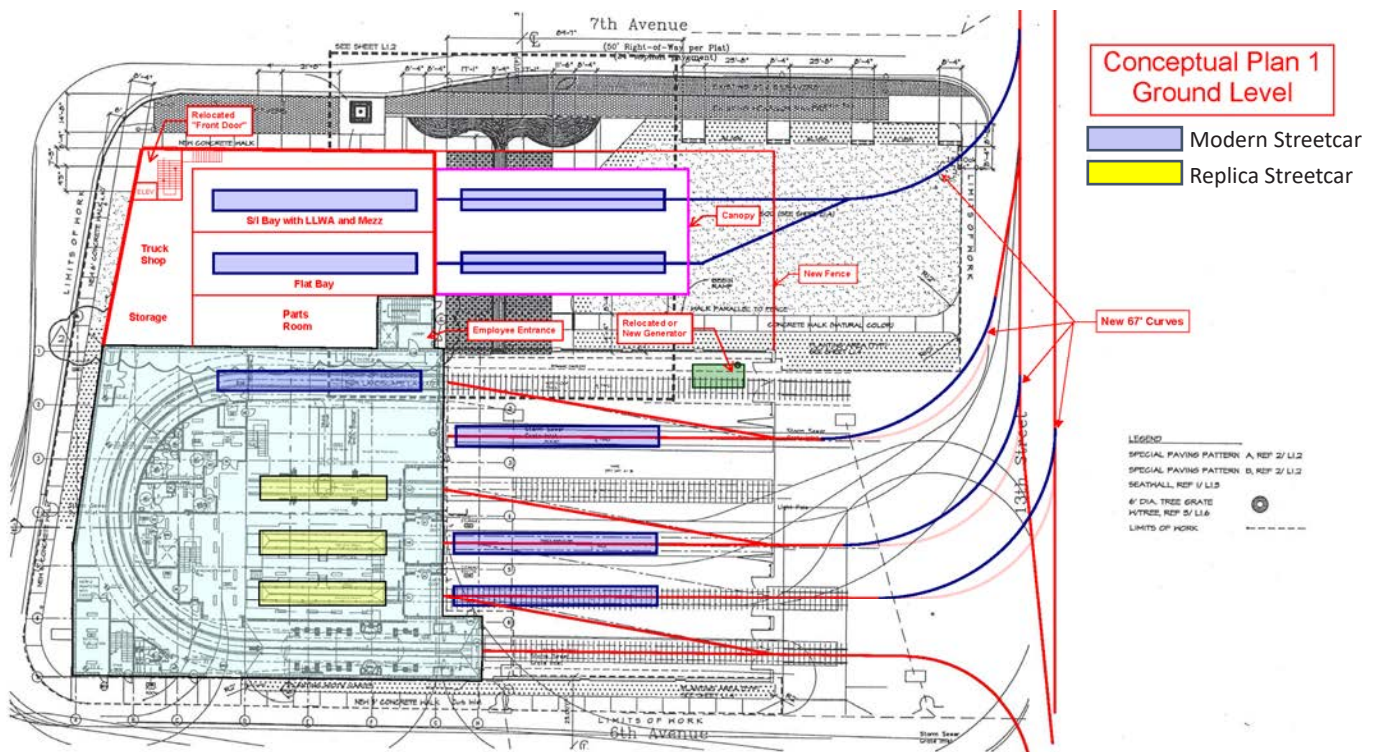


Figure 25. VMF Conceptual Plan 1



two modern streetcars to park beneath. This is also where a new portable walk-around washer would be used to clean the outside of the vehicles.

Other modifications to the ground level would be to expand the site fencing for security and relocating or replacing the generator. Conceptual Plan 1 has eight available parking spots for the new modern streetcars. Only three of these spots would be enclosed, two would be covered, and three would be uncovered. New track work and turnouts would also be necessary to allow the streetcars to access the site. The mezzanine level of the plan would have the upper level work platform in the S/I bay to give full access to the top of the new modern streetcar. The flat bay and S/I bay will each be covered by an overhead bridge crane to be sized appropriately. The third level could all be available for future HART administration offices. With the relocated front door, the current third level layout would have to be reworked to accommodate this.

Below is a list of pros and cons associated with implementation of Conceptual Plan 1:

- » Little impact to existing shop operations during construction.
- » Modern streetcars have dedicated service and inspection bays properly sized for the vehicle.
- » New parts room, storage, and truck shop for modern streetcars.
- » New third floor above expanded shop for HART to consolidate office space.
- » Separate new public entrance.
- » Cars can be washed under canopy using a walk-around wash system and high-pressure washer.
- » Existing entrance becomes dedicated for employees only.
- » Majority of undeveloped portions of the site along 7th Avenue required for new expanded shop and canopy.

Conceptual Plan 2

Conceptual Plan 2 (Figure 26) has major impact on the current VMF and its operations as the expansion effects the north side, as well as the east side of the current building. On the north side of the building is a new parts room to help supplement the current undersized parts room. This plan also relocates the “front door” to the west side of the addition. This would become the main entrance for all visitors to the building. A new canopy sized to store six new modern streetcars would also be placed on the north side of the existing facility.

On the east side of the building, there is a new drive-through wash bay that will house all of the wash system equipment and the new drive-through wash system. This system would require the new modern streetcars to access the bay from the east, pull through the washer, then make a reverse movement out of the bay and into either the new canopied storage yard or maintenance bays. The maintenance bays, which include the two S/I bays and the flat bay, would be expanded to the east to accommodate the new modern streetcars. This would include expanding the pits, upper level work area and crane coverage as well. Other modifications to the ground level would be to expand the site fencing for security and relocating/replacing the generator. Conceptual 2 has ten available parking spots for the new modern streetcars. Only four of these spots would be enclosed and six would be covered by the new canopy. New track work and turnouts would also be necessary to move the streetcars onsite.

Below is a list of pros and cons associated with implementation of Conceptual Plan 2:

- » New parts room.
- » All cars under cover.
- » Separate new public entrance.
- » New enclosed wash bay with new drive-through wash system.
- » Existing entrance becomes dedicated for employees only.
- » Undeveloped portions of the site along 7th Avenue required for new canopy and trackwork.
- » Existing shop operations extremely disrupted during construction.
- » Construction of shop extension, upper level work platforms and pits to be phased to minimize impact to daily operations.
- » No new office space for HART.
- » No new truck shop. Existing truck shop will need to service heritage and new modern streetcars
- » Potential for future expansion for additional vehicle storage on the existing site to the north of the existing building.

Conceptual Plan 3

Conceptual Plan 3 (Figure 27) would also have major impacts on the current VMF and its operations, as the expansion is on the north side, as well as the east side of the current building. A large parts room will be added to the north side of building, requiring the relocation or replacement of the generator. On the east side of the building, there is a new drive-through wash bay

Figure 26. VMF Conceptual Plan 2

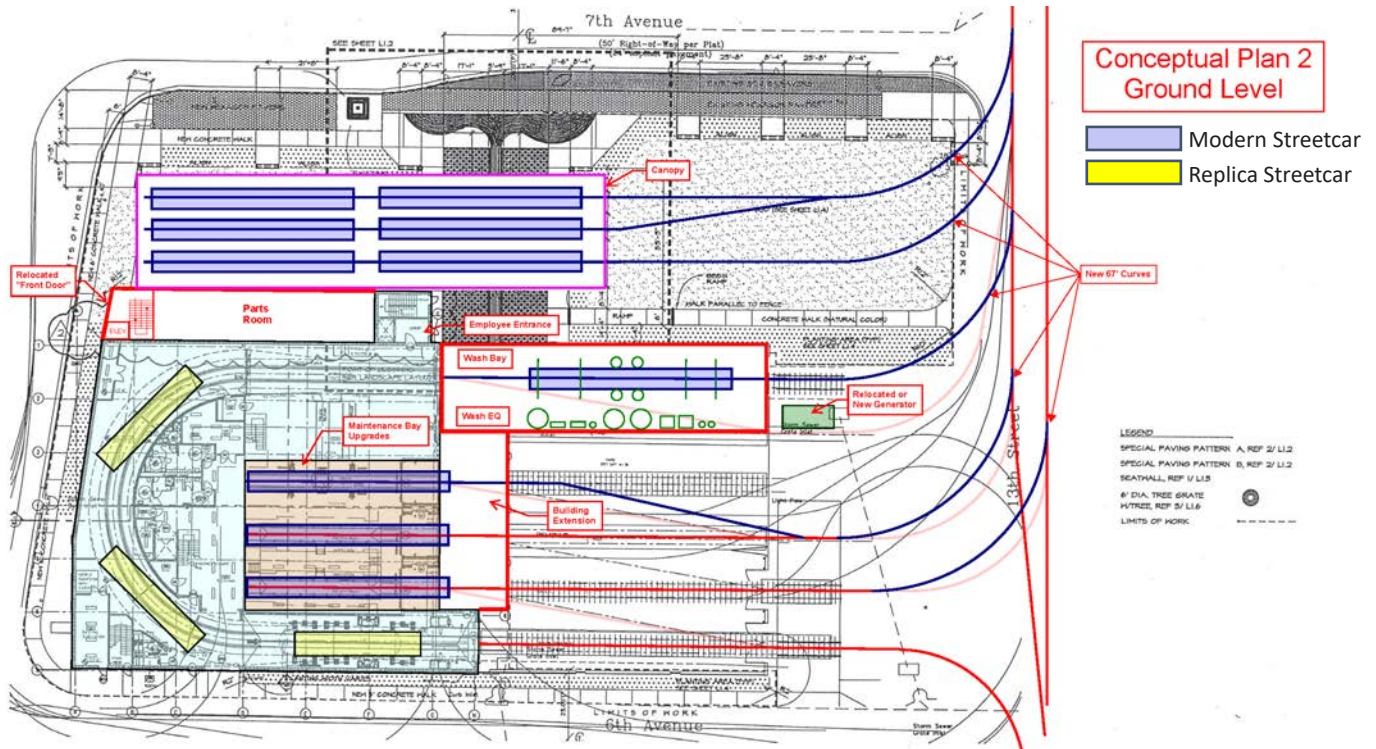
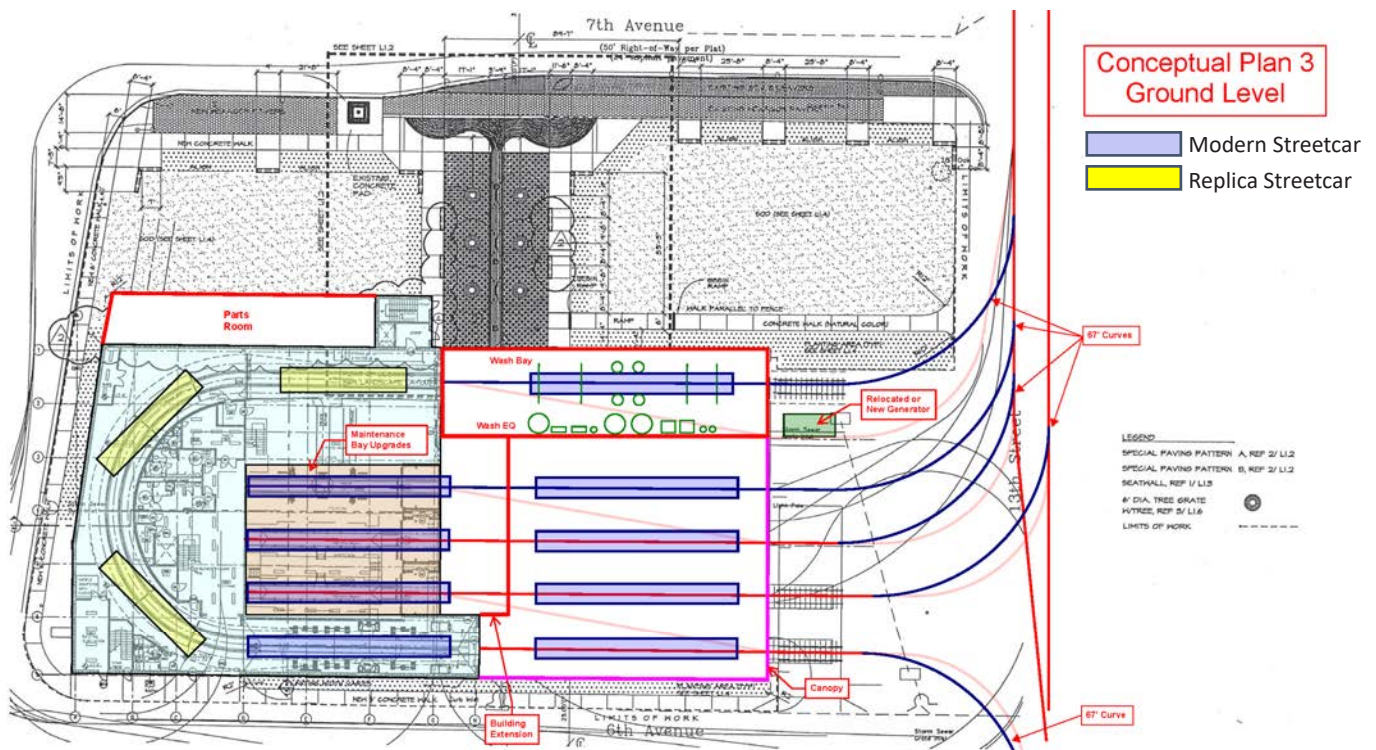


Figure 27. VMF Conceptual Plan 3



that will house all of the wash system equipment and the new drive-through wash system. This system would require the new modern streetcars to access the bay from the east, pull through the washer, then make a reverse movement out of the bay and into either the new canopied storage yard or maintenance bays. The maintenance bays, which include the two S/I bays and the flat bay, would be expanded to the east to accommodate the new modern streetcar. This would include expanding the pits, upper level work area, and crane coverage. Other modifications to the ground level would be to expand the site fencing for security and relocating/replacing the generator. Concept 3 has nine available parking spots for the new modern streetcars. Only five of these spots would be enclosed and four would be covered by the new canopy. New track work and turnouts would also be necessary to move the streetcars onsite.

Below is a list of pros and cons associated with implementation of Conceptual Plan 3:

- » Majority of currently undeveloped portion of the site remains untouched.
- » New parts room.
- » All cars under cover.
- » Existing entrance remains the same for employees and public.
- » New enclosed wash bay with new drive-through wash system.
- » Existing shop operations extremely disrupted during construction.
- » Construction of shop extension, upper level work platforms, and pits to be phased to minimize impact to daily operations.
- » No potential for new office space.
- » No new truck shop. Existing truck shop will need to service heritage and new modern streetcars.

Final VMF conceptual plan selection will occur during the engineering phase of the project.

5. PUBLIC ENGAGEMENT SUMMARY

This study has included extensive public engagement outreach to multiple agencies and stakeholder groups. Outreach and engagement activities conducted from inception of the study through the selection of the preferred project alternative included the following:

- » **Project Branding.** At the onset of the study, the City undertook a project branding effort. A logo and other branding materials were developed for use throughout the study.
- » **Project Website.** The City created a project specific webpage on the City's website: www.tampagov.net/streetcar. The webpage was frequently updated and provided details about the study, frequently asked questions, a study schedule, documents and relevant studies or plans, presentation materials from the public meetings held during the study, an interactive survey, and an on-line comment form. Comments received via the on-line comment form are provided in *Public Engagement & Agency Outreach Summary* report. The City also created a project email address: streetcar@tampagov.net.
- » **Social Media.** Existing City of Tampa social media channels were used to share important information with residents and stakeholders. Notifications about the study and information about the public meetings were shared on the City's Facebook and Twitter accounts.
- » **Presentations, Briefings, and Small Group Meetings.** Several presentations, briefings, and small group meetings were held with local property owners, community groups, and others with an interest in the project. These meetings provided opportunities for staff and project team members to educate participants and solicit feedback on the project.
- » **Stakeholder Meetings.** Two key stakeholder meetings were held primarily with city and county agency representatives to share project information and provide opportunities for participants to voice comments and concerns. The first stakeholder meeting took place on March 23, 2017. The second stakeholder meeting took place on April 6, 2017. Both meetings were held at the Tampa Municipal Office Building. At these initial meetings stakeholders received an update on the study goals and schedule, and a report on initial fundings from

the project context assessment. A third stakeholder meeting was held on December 12, 2018 to review the preferred project alternatives.

- » **Public Workshops.** Five large-scale public workshops were held to provide information and solicit input. The meetings were publicized through news release to local media, via social media, and with targeted email notices to key stakeholders. The City also created public Facebook Events for all of the workshops, which were pushed to the news feeds of anyone who follows the City of Tampa's Facebook page.
 - » The first public workshop focused on purpose and need and was held on March 7, 2017 from 5:30 to 7:30 p.m. at the Tampa Bay History Center. Approximately 100 participants attended.
 - » The second public workshop focused on corridor options and was held on April 4, 2017 from 5:30 to 7:30 p.m. at the Tampa Bay History Center. Approximately 60 participants attended.
 - » The third workshop was a results roundtable and was held on May 2, 2017 from 5:30 to 7:30 p.m. in the Ybor Room at the Hillsborough Community College, Ybor City Campus. Approximately 80 participants attended.
 - » The fourth public workshop introduced the draft preferred alignment and was held on October 24, 2017 from 5:30 to 7:30 p.m. at the Chester H. Ferguson Law Center. Approximately 55 participants attended.
 - » The fifth public workshop was held to review preferred project alternatives on December 12, 2018. This workshop was organized as a presentation followed by an open house, and took place at the Tampa River Center at Julian B. Lane Park. Approximately 100 participants attended.
- » **Online Survey.** The City conducted an on-line survey asking residents about their thoughts on the *InVision: Tampa Streetcar* project. Eight hundred and thirty five (835) people responded to the on-line survey, which was open from February 23 through March 27, 2017 on the study website.
- » **Media Coverage.** Local news media coverage was extensive and numerous stories and articles were written in support of the project and about the public meetings that were held.

For more detailed information on public engagement activities, please refer to the full report—*Public Engagement & Agency Outreach Summary*—on the City of Tampa's InVision: Tampa Streetcar project website at www.tampagov.net/streetcar.

*Figure 28. Preferred Alternatives Open House
(December 12, 2018)*



APPENDIX A - ALIGNMENT EVALUATION PROCESS

Table 1. Alignment Options - Summary Evaluation Table

Evaluation Category	North/South			East/West		Loop	
	A N/S Franklin Street	B N/S Tampa Street- Florida Avenue Couplet	C E/W West River- Ybor City	D E/W North Hyde Park-Channel District	E E/W North Hyde Park-Convention Center Couplet	F Loop Downtown- Channel District	G Loop Downtown- Ybor City
Alignment Information							
Track Miles	2.67	2.60	4.66	4.94	3.27	2.46	4.12
Number of Vehicles	4	4	7	7	5	4	6
Capital Costs (\$2017)	\$94 million	\$97 million	\$174 million	\$180 million	\$124 million	\$91 million	\$138 million
Annual O&M Costs	\$3.6 million	\$3.6 million	\$6.2 million	\$6.2 million	\$4.4 million	\$3.6 million	\$5.3 million
Average Weekday Boardings (2020)	2,200	2,200	2,450	2,700	1,500	2,300	2,300
Population & Employment within 1/4 mile (2020)	20,600	24,100	29,900	31,200	15,100	20,400	22,000
Purpose & Need Considerations							
Connect Downtown Districts	●	●	●	●	●	●	●
Serve Diverse Travel Markets	●	●	●	●	●	●	●
Improve First Mile/Last Mile Connections	●	●	●	●	●	●	●
Support Economic Development	●	●	●	●	●	●	●
Expand Sustainable Transportation Options	●	●	●	●	●	●	●
Performance & Impact							
Population & Employment Served	●	●	●	●	●	●	●
Capital & Operating Costs	●	●	●	●	●	●	●
Cost Effectiveness	●	●	●	●	●	●	●
Constructability/Operational Constraints	●	●	●	●	●	●	●
Traffic & Parking Impacts	●	●	●	●	●	●	●
Community & Environment Impacts	●	●	●	●	●	●	●
OVERALL RATING							
	●	●	●	●	●	●	●

Table 2. Alignment Options - Detailed Evaluation Table

CATEGORY MEASURES SUBMEASURES	Alignment A N/S Franklin		Alignment B N/S Tampa-Florida Couplet		Alignment C E/W West River-Ybor		Alignment D E/W North Hyde Park-Channel District		Alignment E E/W North Hyde Park- Convention Center Couplet		Alignment F Loop Downtown-Channel District		Alignment G Loop Downtown-Ybor	
	MEASURE	RATING	MEASURE	RATING	MEASURE	RATING	MEASURE	RATING	MEASURE	RATING	MEASURE	RATING	MEASURE	RATING
Purpose & Need Considerations														
Connect Downtown Districts														
Serves Downtown Core	yes	5.0 ●	yes	5.0 ●	yes	5.0 ●	yes	5.0 ●	no	1.0 ●	yes	5.0 ●	yes	5.0 ●
Serves emerging subdistricts		1.8 ●		1.8 ●		3.0 ●		2.6 ●		1.8 ●		1.8 ●		2.2 ●
Tampa Heights	yes	5	yes	5	no	1	no	1	no	1	no	1	yes	5
Grand Central/UT	no	1	no	1	partial	3	partial	3	partial	3	no	1	no	1
Central Park/Encore!	no	1	no	1	partial	3	partial	3	no	1	yes	5	partial	3
North Hyde Park	no	1	no	1	partial	3	yes	5	partial	3	no	1	no	1
West River	no	1	no	1	yes	5	no	1	no	1	no	1	no	1
AVERAGE RATING		3.4 ●		3.4 ●		4.0 ●		3.8 ●		1.4 ●		3.4 ●		3.6 ●
Serve Diverse Travel Markets														
Serves the greatest population/employment within 1/4 mile (2020) - extension only		3.0 ●		3.0 ●		4.0 ●		4.0 ●		1.0 ●		4.0 ●		3.0 ●
Population/employment within 1/4 mile (2020) - extension only	20,639	3	24,080	3	29,865	5	31,202	5	15,075	1	20,393	3	21,962	3
Acreage within 1/4 mile buffer - extension only	434	*	483	*	626	*	640	*	569	*	231	*	486	*
Average Activity Density within 1/4 mile (2020) - extension only	48	3	50	3	48	3	49	3	26	1	88	5	45	3
Provides access for transit-dependent population within 1/4 mile		2.0 ●		2.0 ●		3.0 ●		2.0 ●		1.0 ●		1.5 ●		2.5 ●
High (Central Park/Encore)	no	1	no	1	partial	3	no	1	no	1	partial	3	partial	3
High (West River)	no	1	no	1	yes	5	no	1	no	1	no	1	no	1
Moderate (Tampa Heights)	yes	5	yes	5	no	1	no	1	no	1	no	1	yes	5
Moderate (North Hyde Park)	no	1	no	1	partial	3	yes	5	no	1	no	1	no	1
Connects major destinations and parks within 1/4 mile	11	5.0 ●	12	5.0 ●	12	5.0 ●	11	5.0 ●	3	1.0 ●	8	3.0 ●	11	5.0 ●
# cultural/entertainment/tourism venues	6	*	6	*	7	*	7	*	2	*	5	*	6	*
# educational institutions (UT, Stetson, Brewster)	2	*	2	*	1	*	1	*	0	*	0	*	2	*
# parks	3	*	4	*	4	*	3	*	1	*	3	*	3	*
AVERAGE RATING		3.3 ●		3.3 ●		4.0 ●		3.7 ●		1.0 ●		2.8 ●		3.5 ●
Improve First Mile/Last Mile Connections														
Provides connection to existing regional transit hubs		5.0 ●		5.0 ●		4.0 ●		2.0 ●		1.0 ●		2.0 ●		5.0 ●
# blocks from Marion Transit Center (MTC)	2	5	1	5	3	4	6	2	12	1	6	2	2	5
Provides connection to existing regional & local transit services		2.7 ●		4.0 ●		4.7 ●		4.0 ●		2.3 ●		3.7 ●		3.7 ●
# blocks from Tampa Union Station	6	2	5	3	1	5	1	5	12	1	0	5	6	2
# blocks from Greyhound station	3	4	2	5	1	5	4	4	10	1	1	5	3	4
# bus stops located within 2 blocks of alignment	23	2	30	4	33	4	26	3	39	5	16	1	38	5
Provides connection to potential new regional transit hubs		5.0 ●		5.0 ●		4.0 ●		4.0 ●		2.0 ●		3.0 ●		5.0 ●
# regional transit corridors serving Downtown intersected (4 max)	4	5	4	5	3	4	3	4	1	2	2	3	4	5
AVERAGE RATING		4.2 ●		4.7 ●		4.2 ●		3.3 ●		1.8 ●		2.9 ●		4.6 ●

Table 3. Preferred Alternative - Detailed Evaluation Table

Decision Factor	Measure	Florida Borein to Harrison				Florida Harrison to Palm	Tampa Palm to Harrison		Tampa Tyler to Kennedy		Tampa Kennedy to Whiting	Franklin Tyler to Palm
		1.1	1.2	1.3	1.4	2.1	3.1	3.2	4.1	4.2	5.1	6.1
		W Exclusive	W Shared	E Exclusive	E Shared	E Shared	E Exclusive	E Shared	E Exclusive	E Shared	E Shared	E Shared
Maximizes Transit Travel Time Reliability		● 5.0	● 2.3	● 5.0	● 3.0	● 2.0	● 5.0	● 3.7	● 5.0	● 2.3	● 1.0	● 1.7
Transit Travel Time Reliability	5 if exclusive / 1 if shared	5.0	1.0	5.0	1.0	1.0	5.0	1.0	5.0	1.0	1.0	1.0
Potential for Parking to Block Guideway	5 if no shared lane adjacent to parking / 1 if adjacent	5.0	1.0	5.0	3.0	N/A	5.0	5.0	5.0	1.0	1.0	1.0
Turning Que Conflicts	5 if avoids turning ques and ramps / 3 if modest conflicts / 1 if significant	5.0	5.0	5.0	5.0	3.0	5.0	5.0	5.0	5.0	1.0	3.0
Minimizes Traffic, Bike Lane, & Parking Impacts		● 3.5	● 4.0	● 3.5	● 4.0	● 3.7	● 3.0	● 4.0	● 4.0	● 4.0	● 3.0	● 3.7
Traffic Impacts	5 if no lanes removed and exclusive / 3 if shared or exclusive lane removed / 1 if lane removed	5.0	3.0	5.0	3.0	3.0	5.0	3.0	5.0	3.0	3.0	3.0
Bike Lane Impacts	5 if remain / 3 if relocated / 1 if removed	3.0	5.0	3.0	5.0	3.0	3.0	5.0	3.0	3.0	3.0	N/A
On-Street Parking Impacts	5 if min loss or potential to add parking / 3 if mod loss /1 if max loss	3.0	5.0	3.0	5.0	N/A	1.0	5.0	3.0	5.0	5.0	5.0
Driveway/Alley Access Crossings	5 if low number of curb cuts relative to segment / 3 if moderate / 1 if high	3.0	3.0	3.0	3.0	5.0	3.0	3.0	5.0	5.0	1.0	3.0
Allows for Shared Transit Use		● 5.0	● 1.0	● 3.0	● 5.0	● 5.0	● 5.0	● 1.0	● 5.0	● 1.0	N/A	● 5.0
Guideway Supports Shared Use	5 if all right side shared stop / 3 if both side stops required / 1 if no right side stop	5.0	1.0	3.0	5.0	5.0	5.0	1.0	5.0	1.0	N/A	5.0
Minimizes Costs for ROW & Street Reconstruction		● 2.7	● 3.3	● 2.0	● 3.3	● 2.7	● 2.0	● 2.7	● 3.3	● 3.3	● 5.0	● 2.0
Minimizes ROW Requirements	5 if no ROW / 3 if limited for stops / 1 if significant for alignment or turns	5.0	5.0	3.0	5.0	3.0	3.0	3.0	5.0	5.0	5.0	3.0
Minimize Street/Streetscape Reconstruction	5 if minimal impact (shared lane) / 3 if modest (transit lane) / 1 if significant	3.0	5.0	3.0	5.0	5.0	3.0	5.0	5.0	5.0	5.0	3.0
	TOTALS	● 4.0	● 2.7	● 3.4	● 3.8	● 3.3	● 3.8	● 2.8	● 4.3	● 2.7	● 3.0	● 3.1

APPENDIX B - PREFERRED EXTENSION GUIDEWAY & STOPS

Figure 1. Extension Guideway & Stops Key Sheet

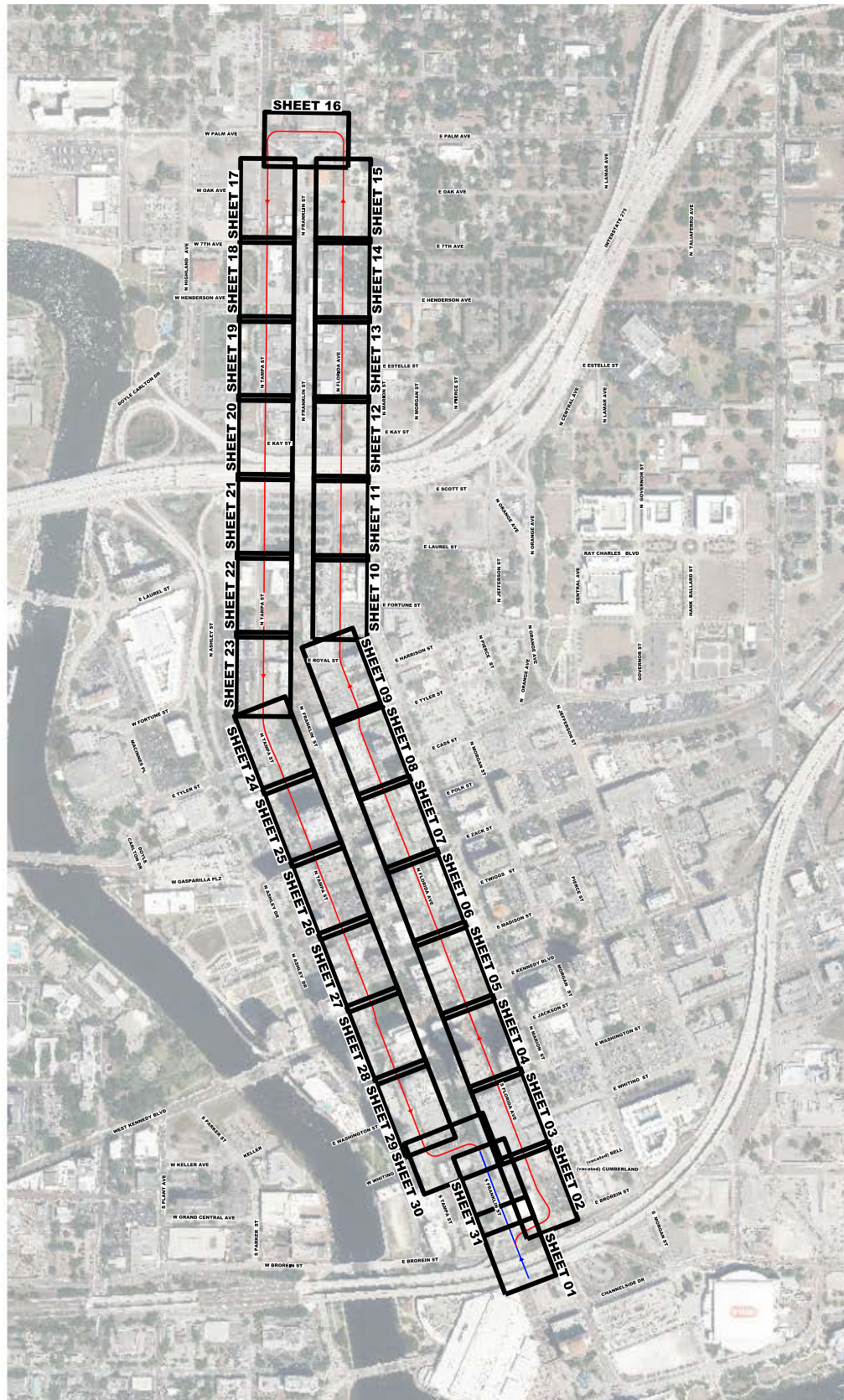


Figure 2. Extension Guideway & Stops - Sheet 01

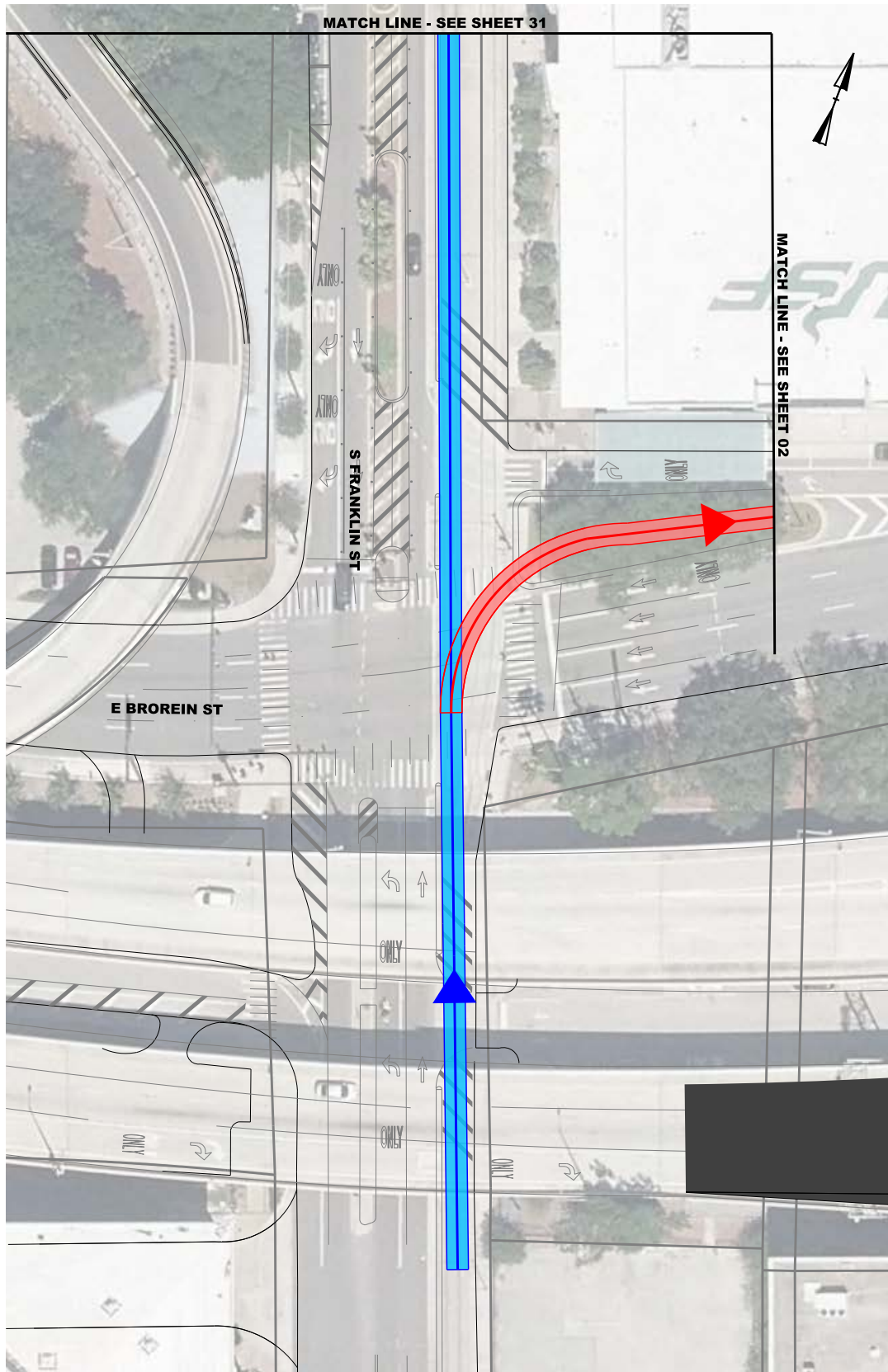


Figure 3. Extension Guideway & Stops - Sheet 02

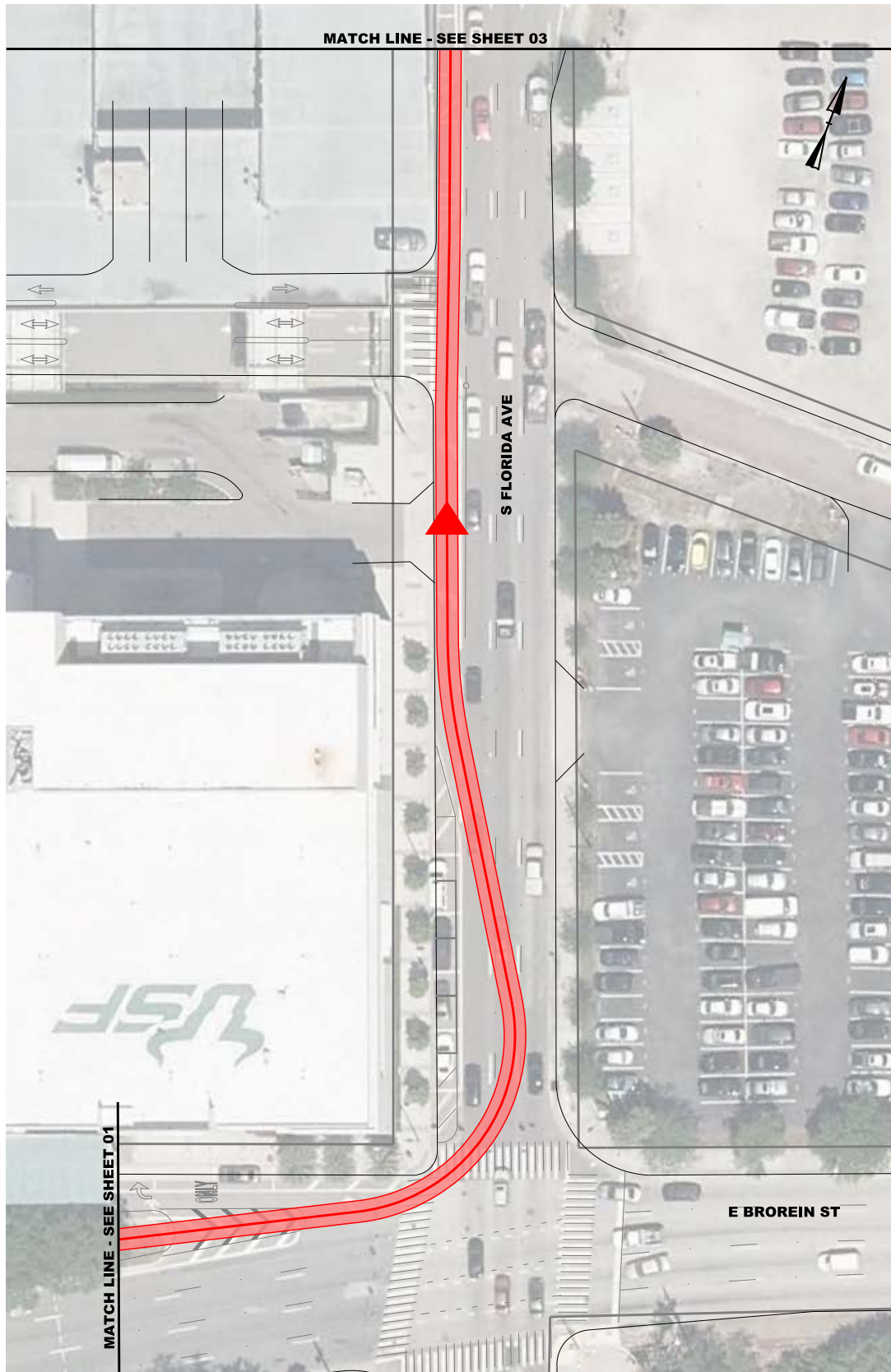


Figure 4. Extension Guideway & Stops - Sheet 03

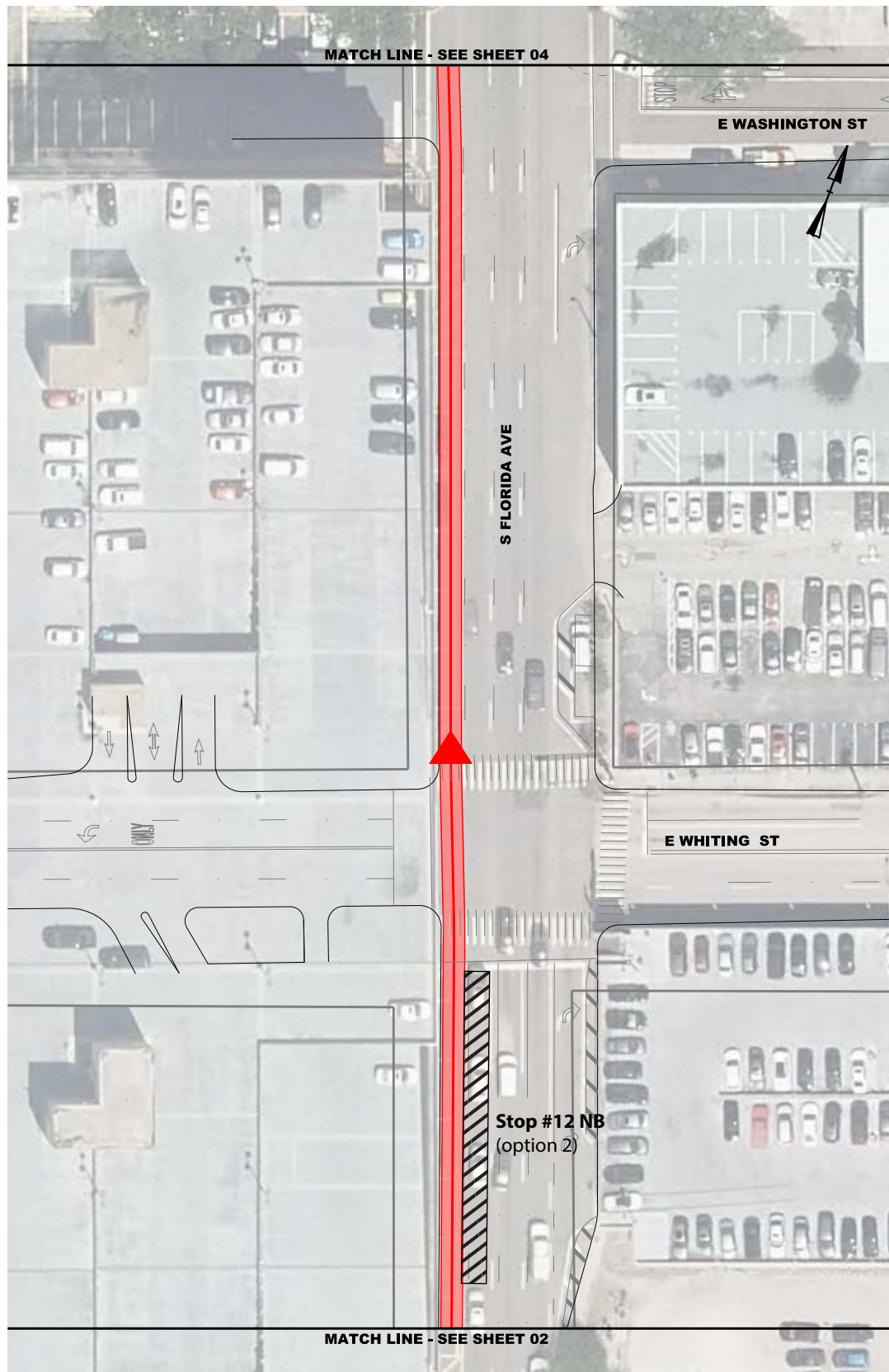


Figure 5. Extension Guideway & Stops - Sheet 04

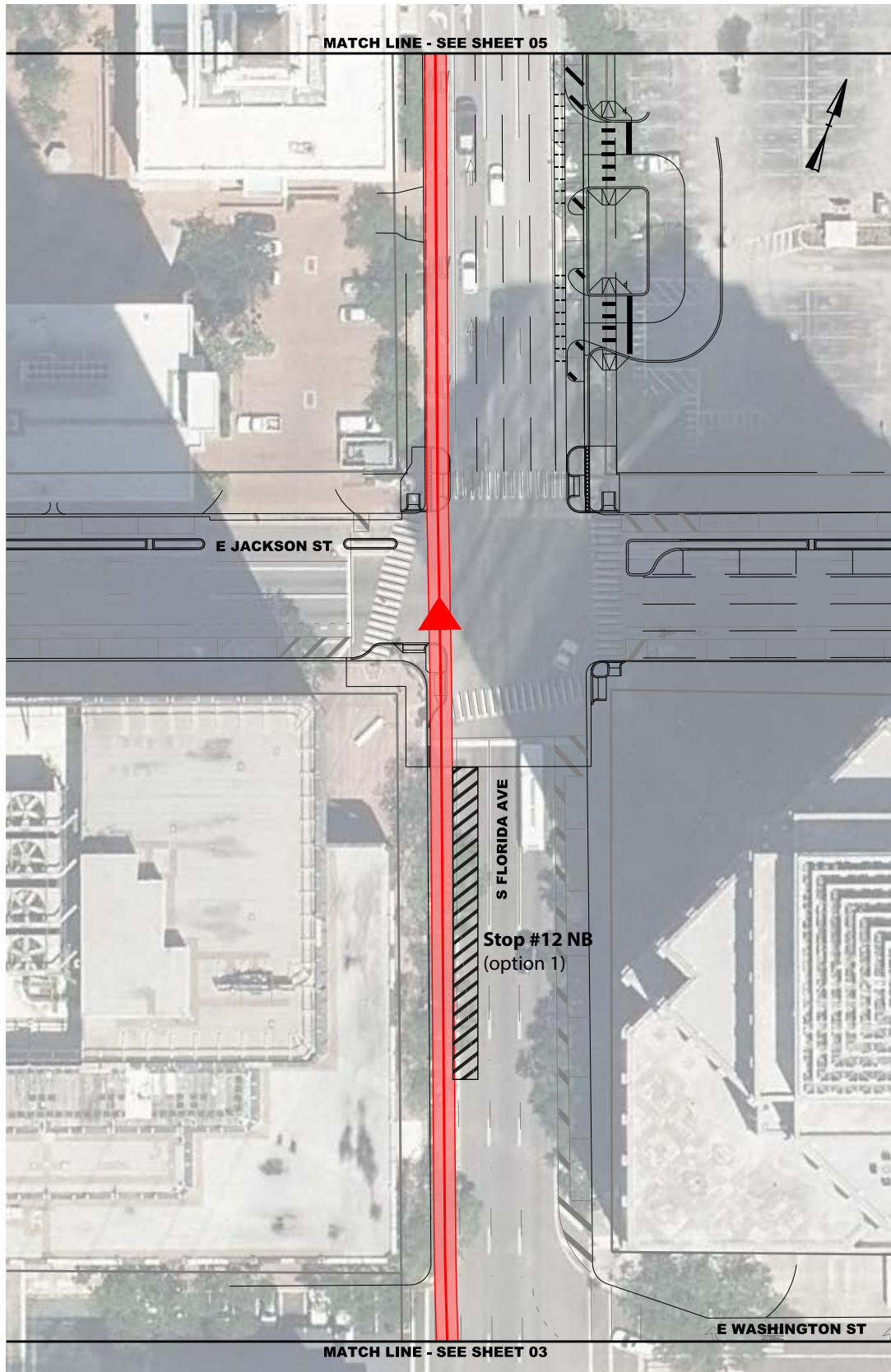


Figure 6. Extension Guideway & Stops - Sheet 05

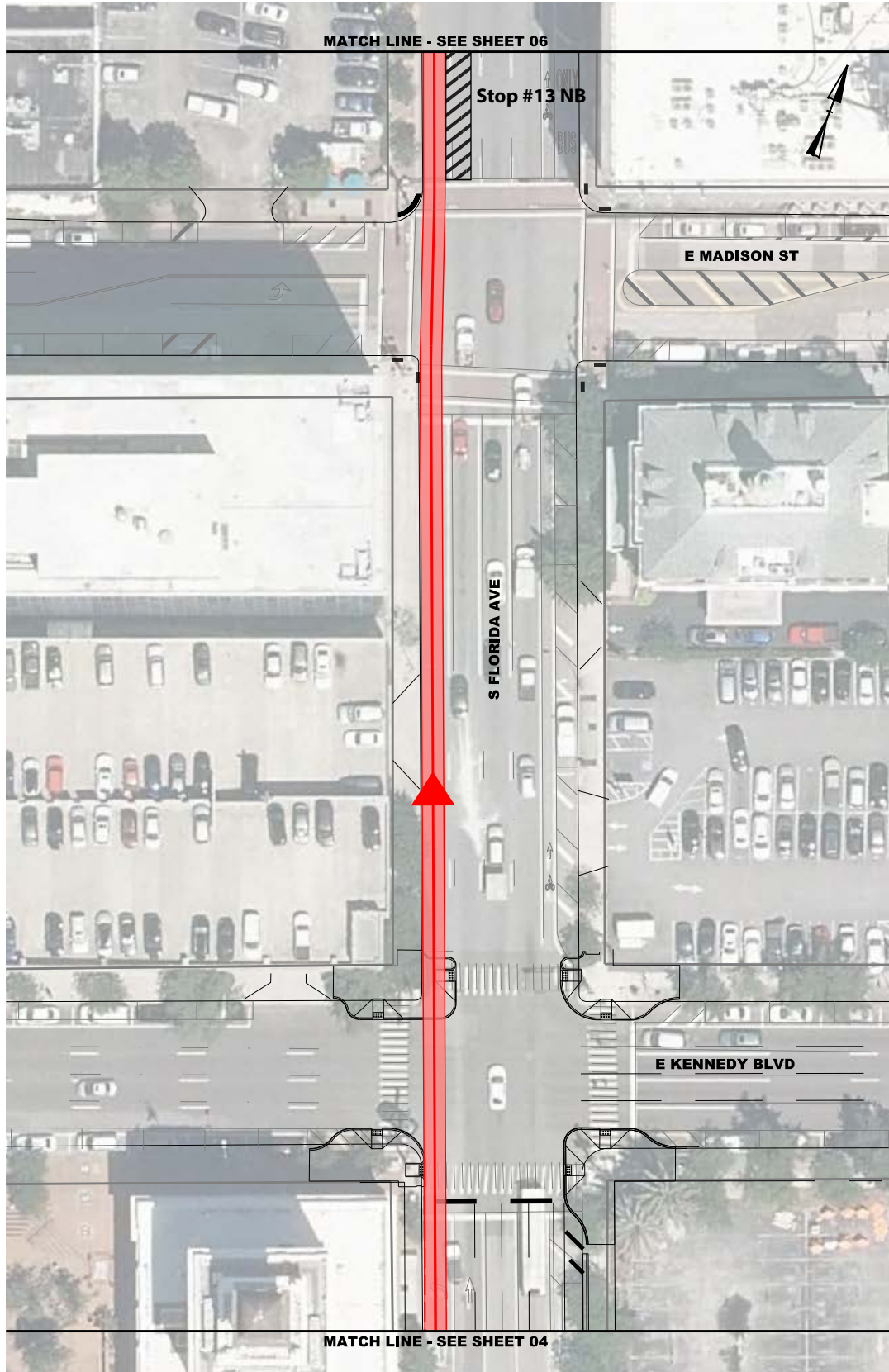


Figure 7. Extension Guideway & Stops - Sheet 06

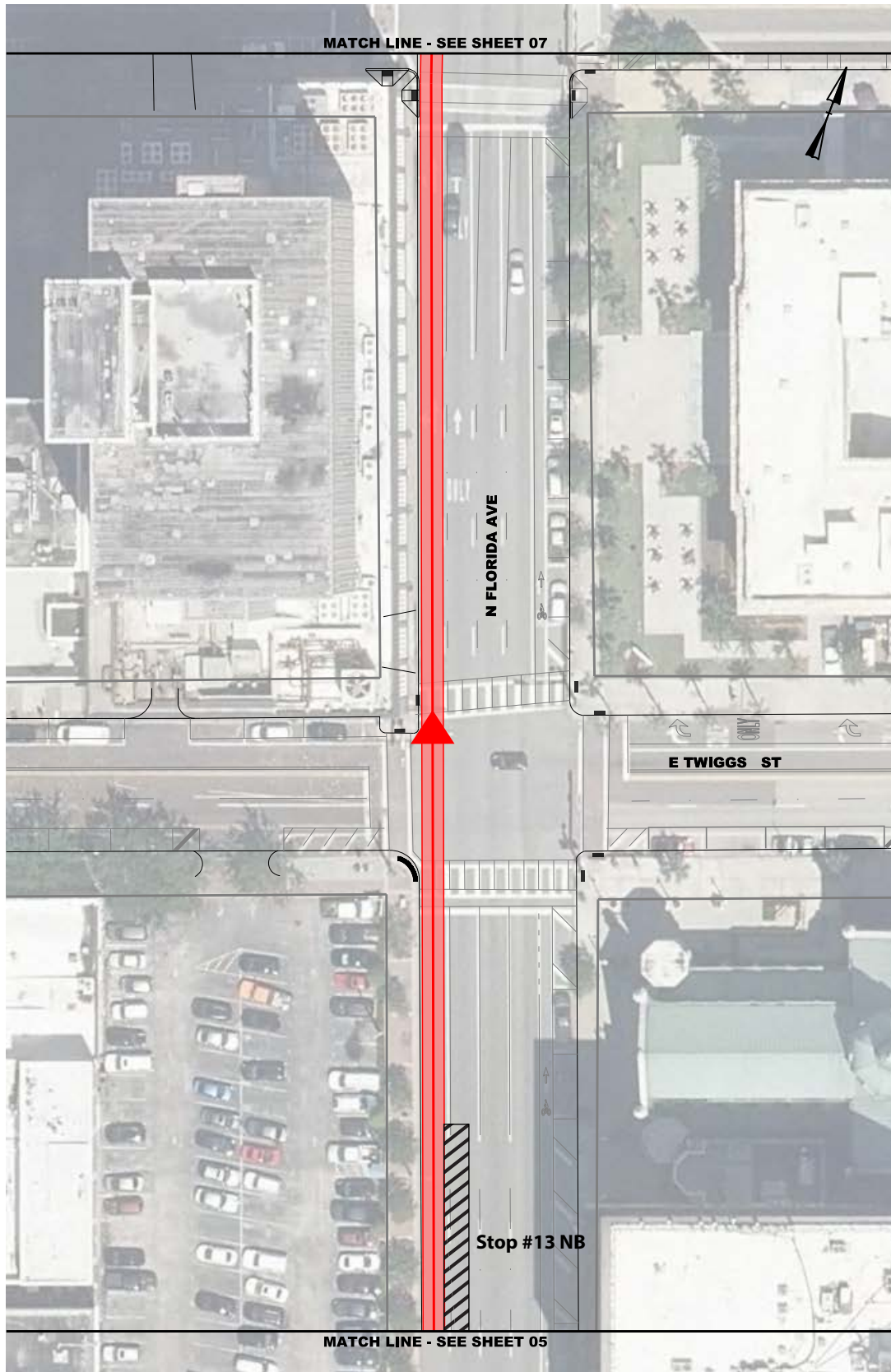


Figure 8. Extension Guideway & Stops - Sheet 07

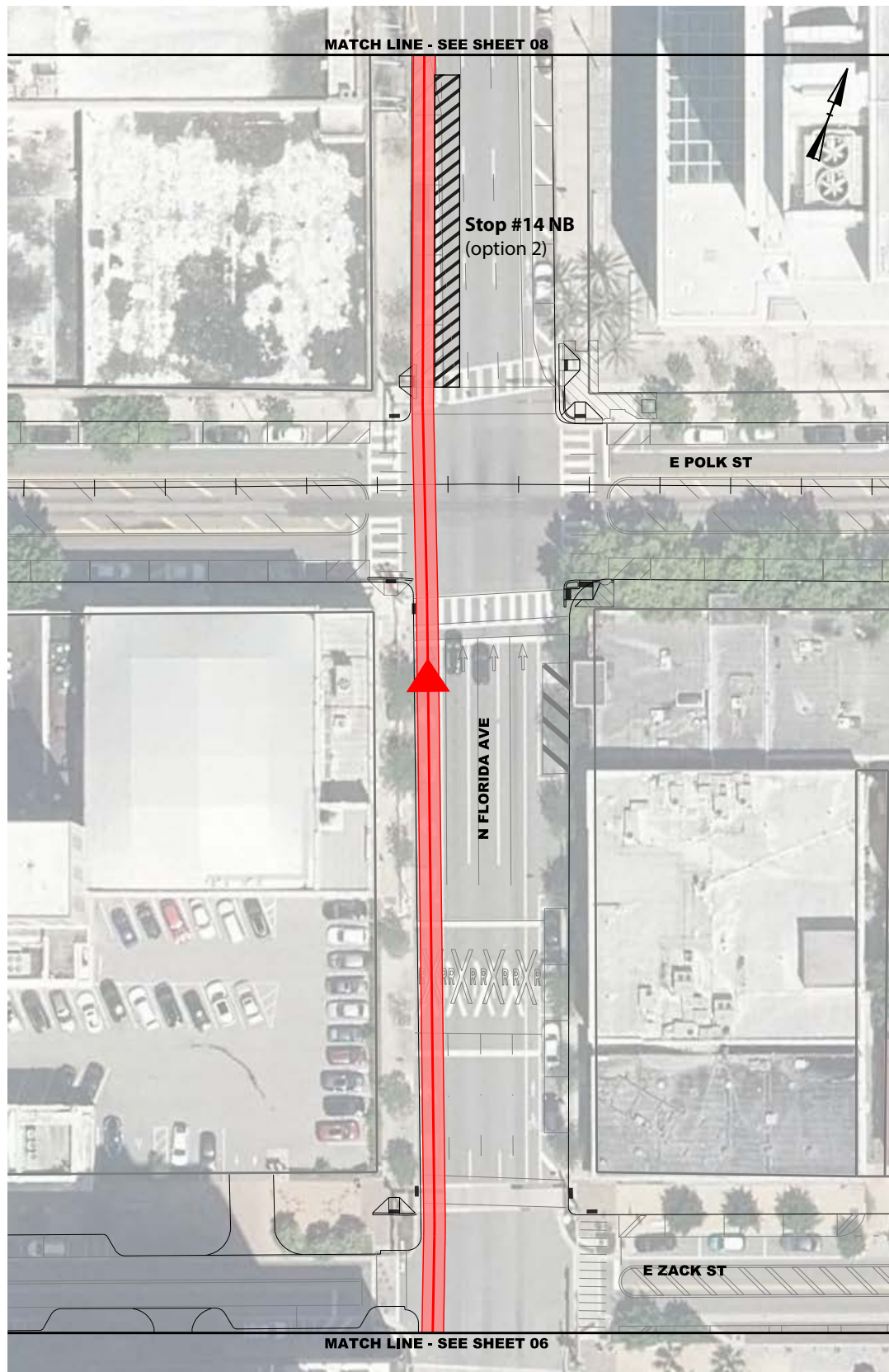


Figure 9. Extension Guideway & Stops - Sheet 08

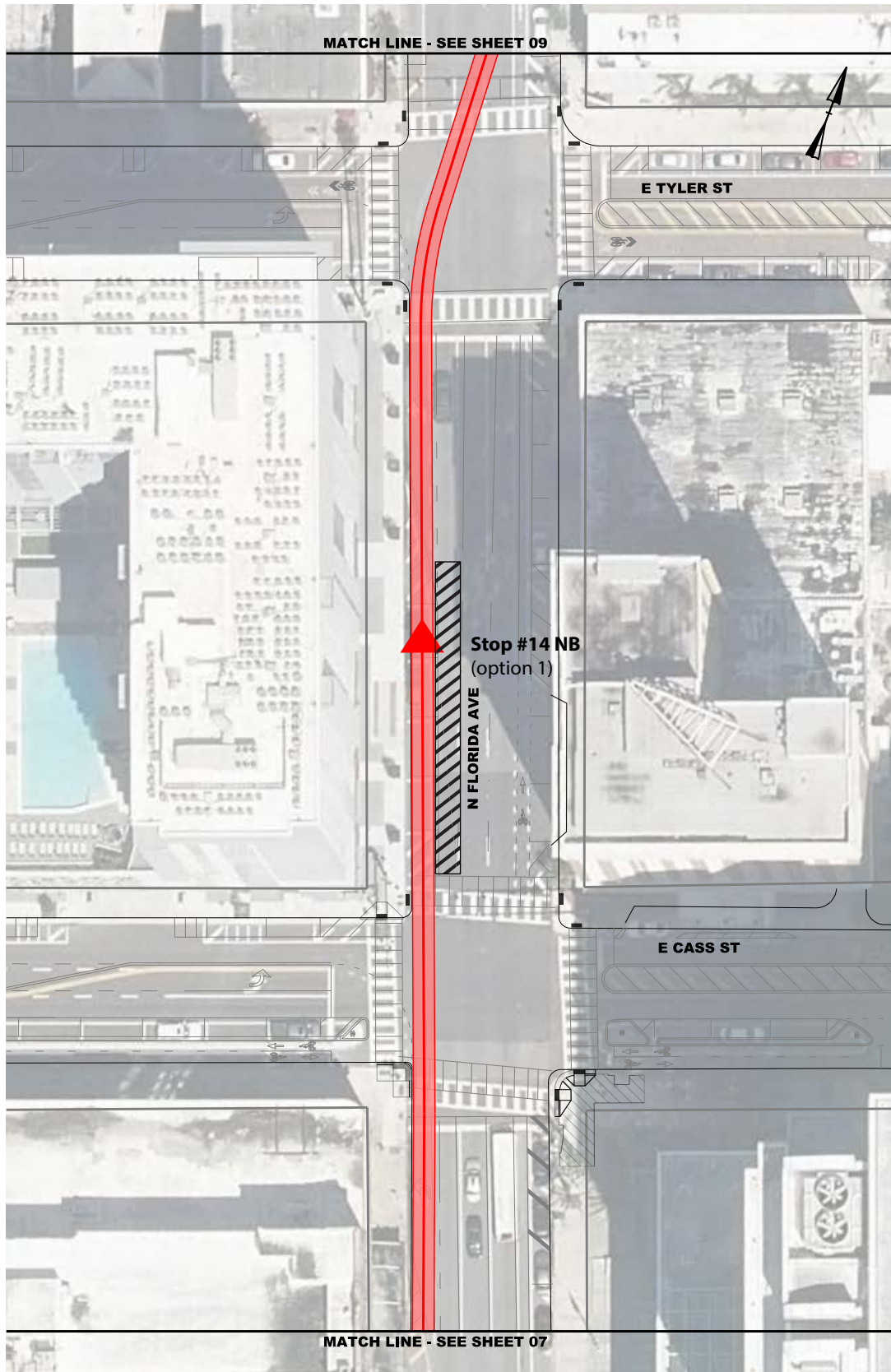


Figure 10. Extension Guideway & Stops - Sheet 09

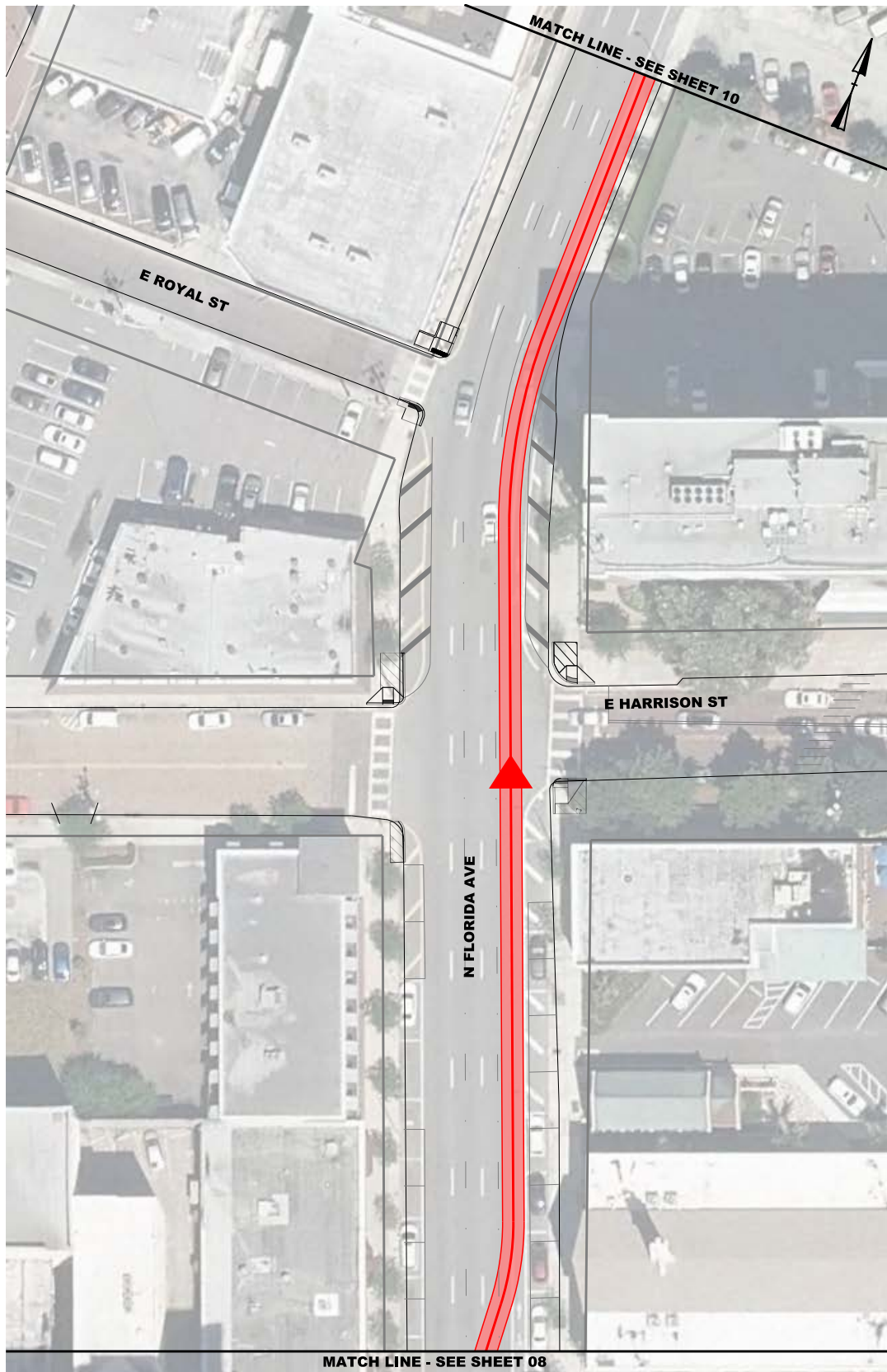


Figure 11. Extension Guideway & Stops - Sheet 10

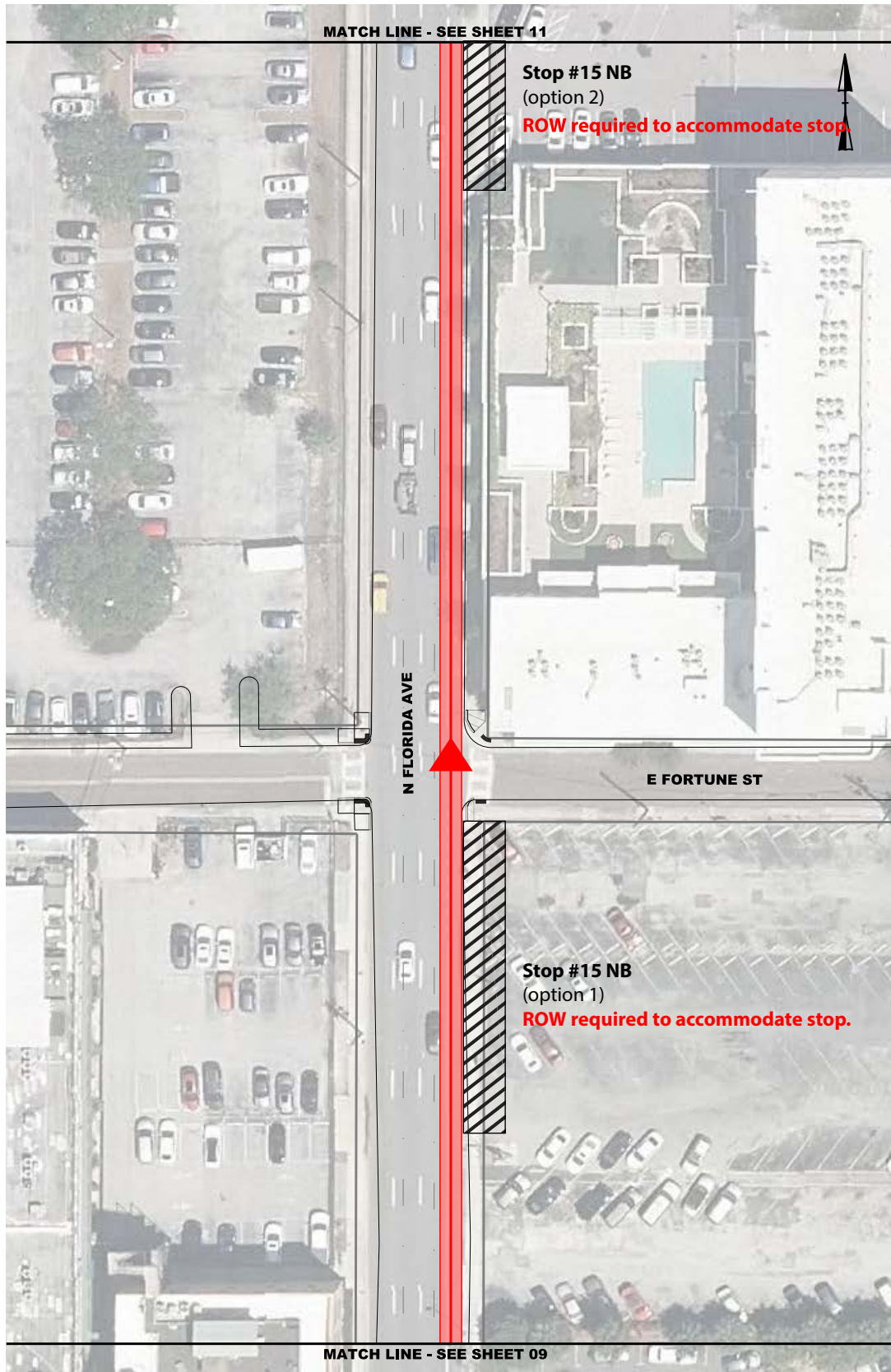


Figure 12. Extension Guideway & Stops - Sheet 11

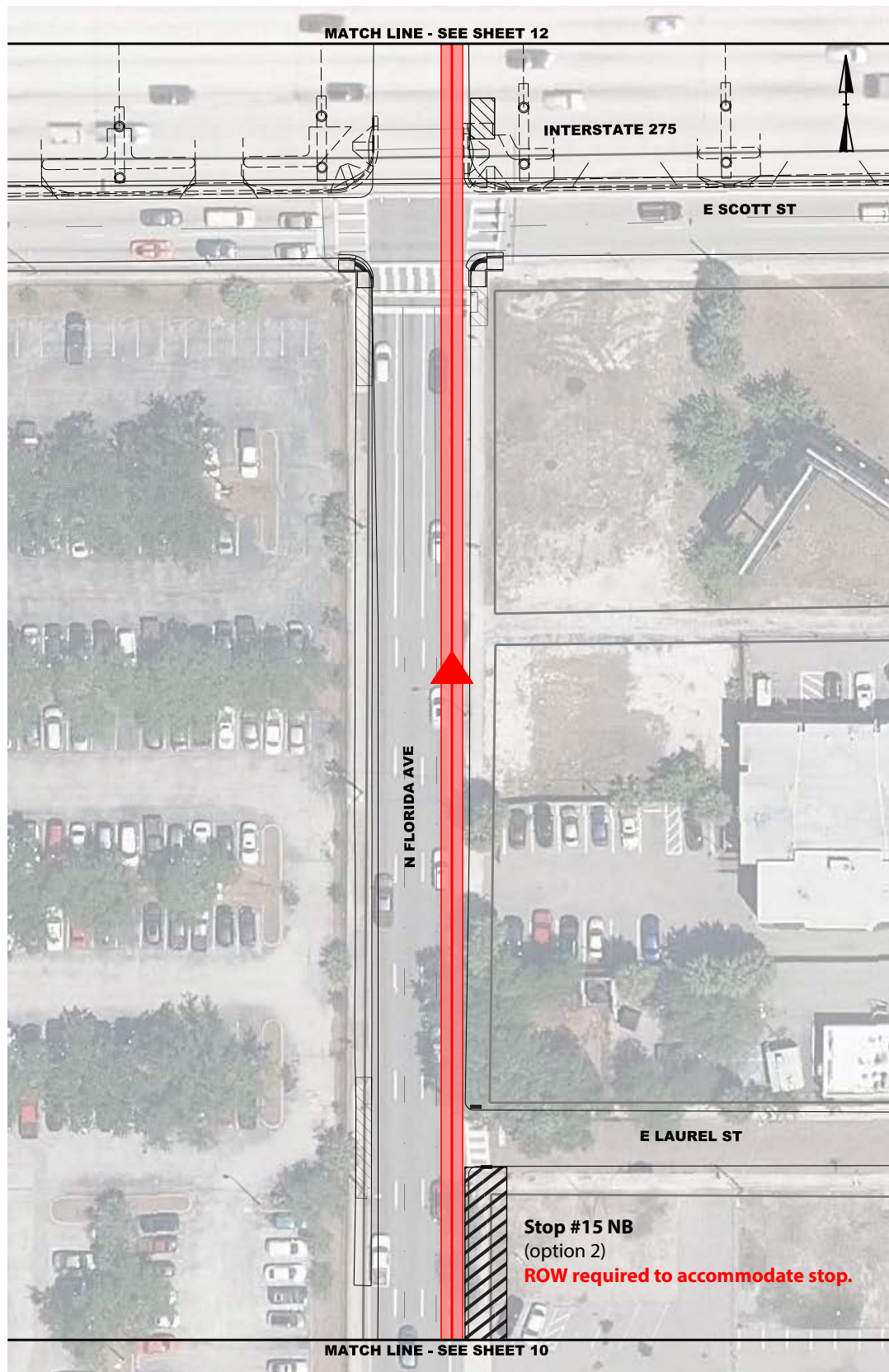


Figure 13. Extension Guideway & Stops - Sheet 12

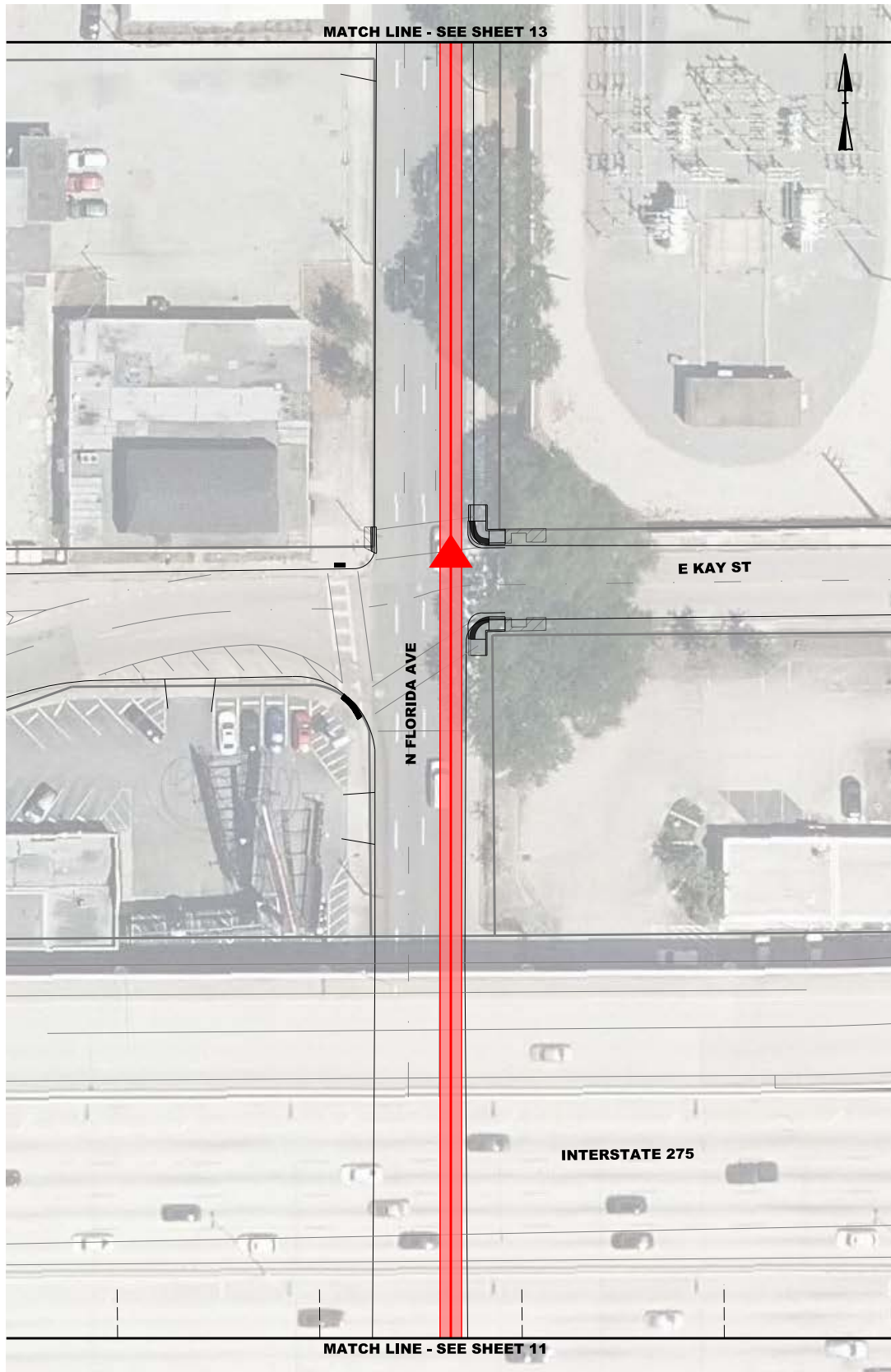


Figure 14. Extension Guideway & Stops - Sheet 13

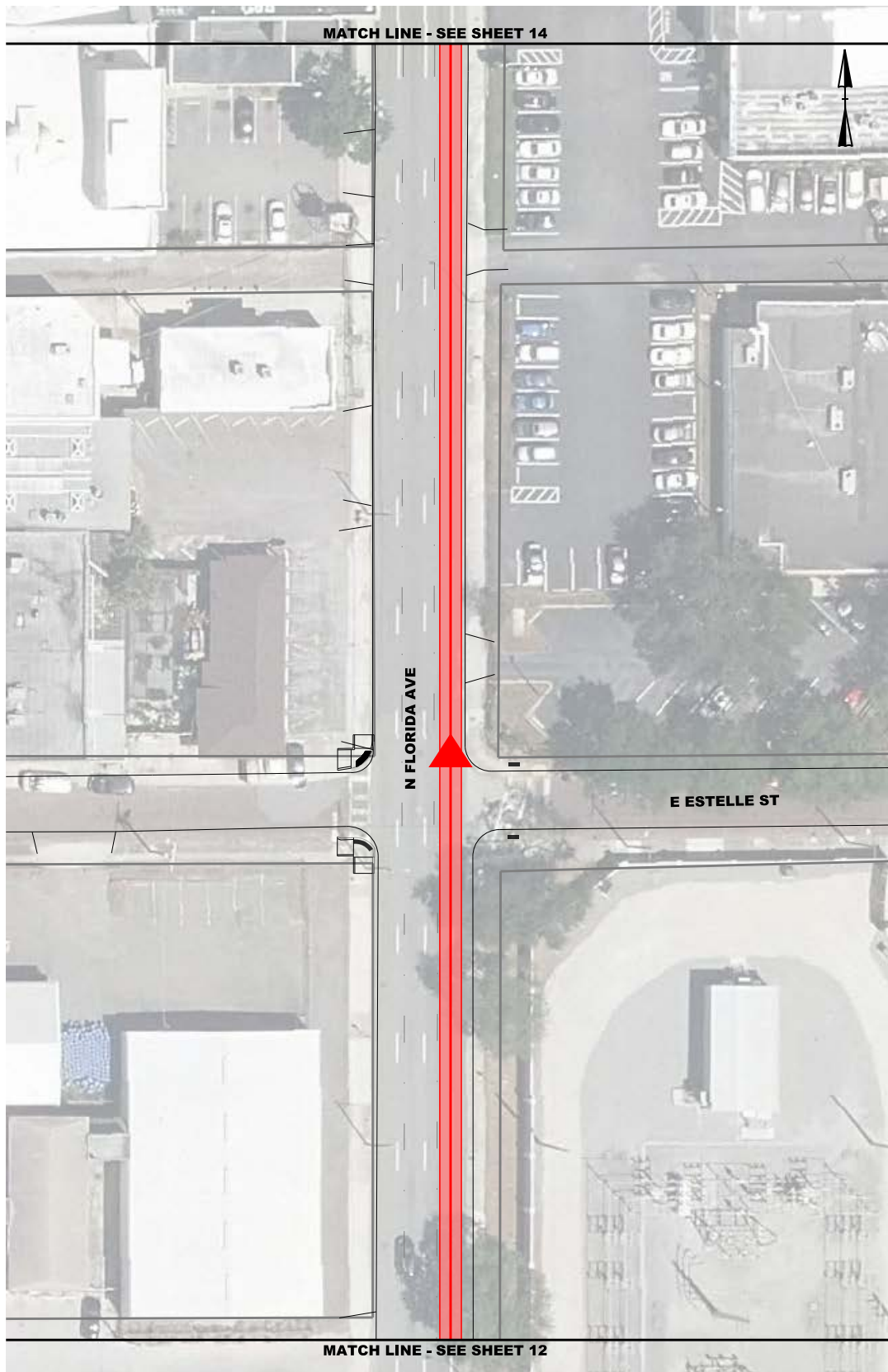


Figure 15. Extension Guideway & Stops - Sheet 14

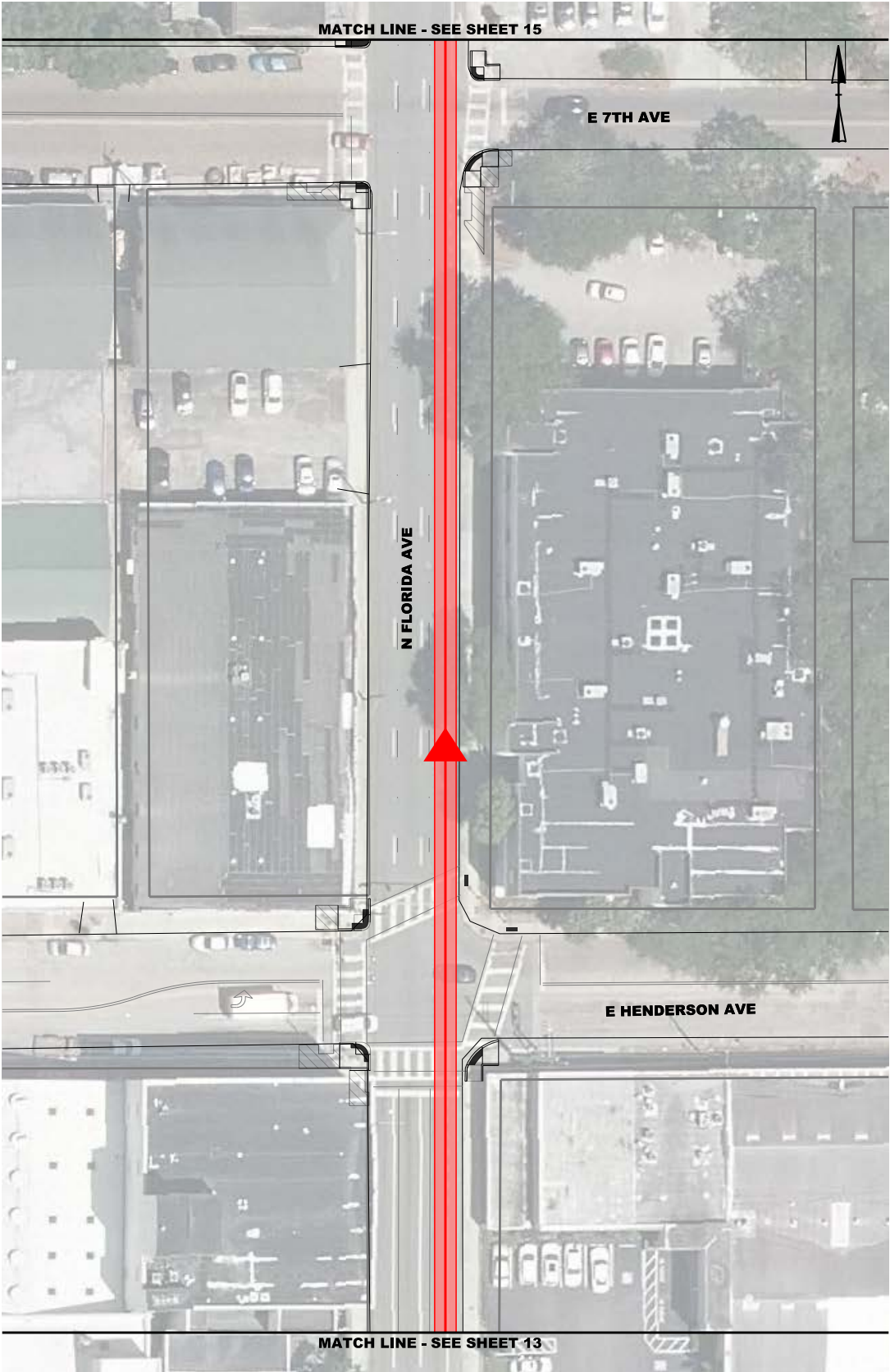


Figure 16. Extension Guideway & Stops - Sheet 15

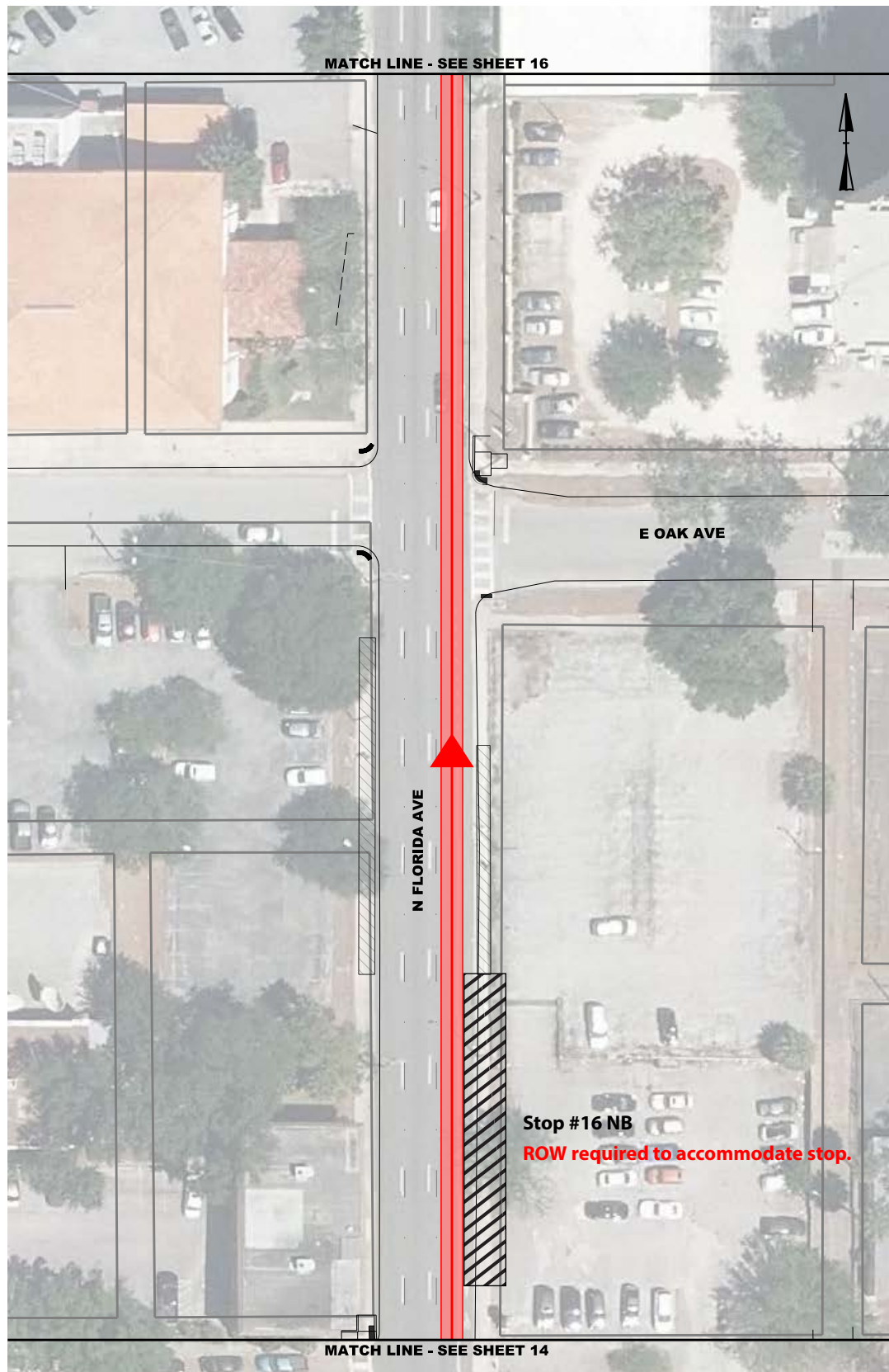


Figure 17. Extension Guideway & Stops - Sheet 16

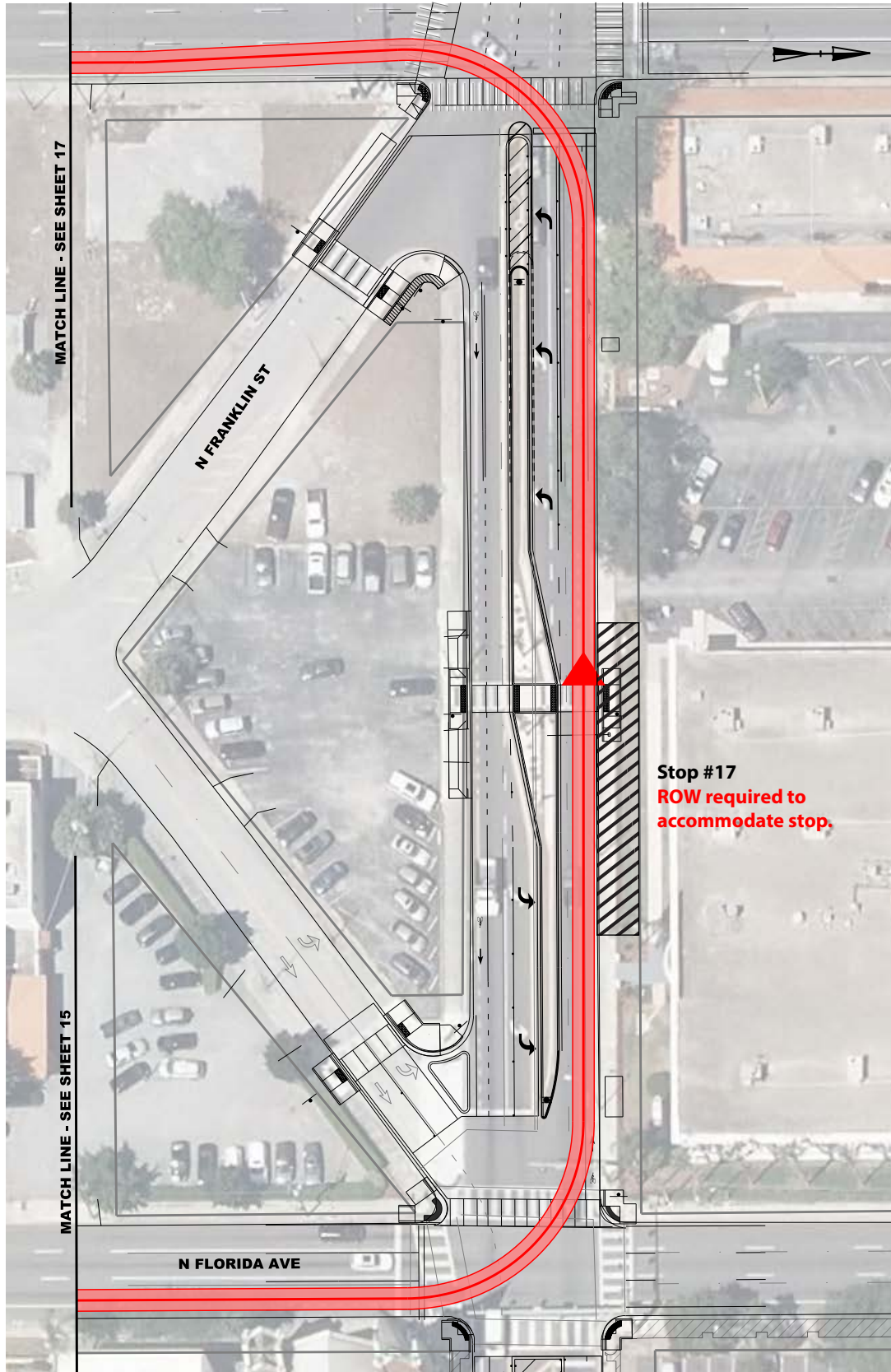


Figure 18. Extension Guideway & Stops - Sheet 17



Figure 19. Extension Guideway & Stops - Sheet 18

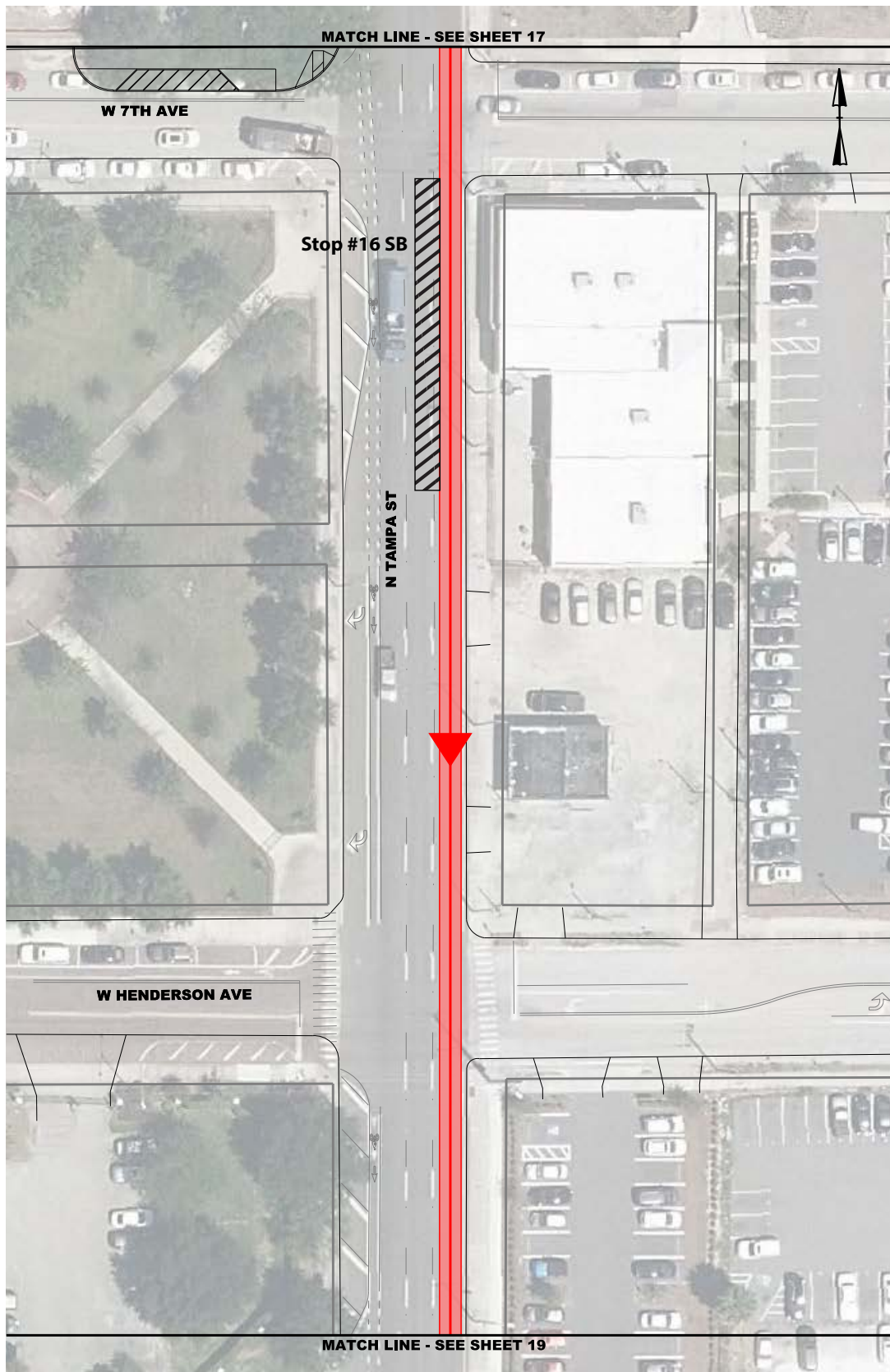


Figure 20. Extension Guideway & Stops - Sheet 19

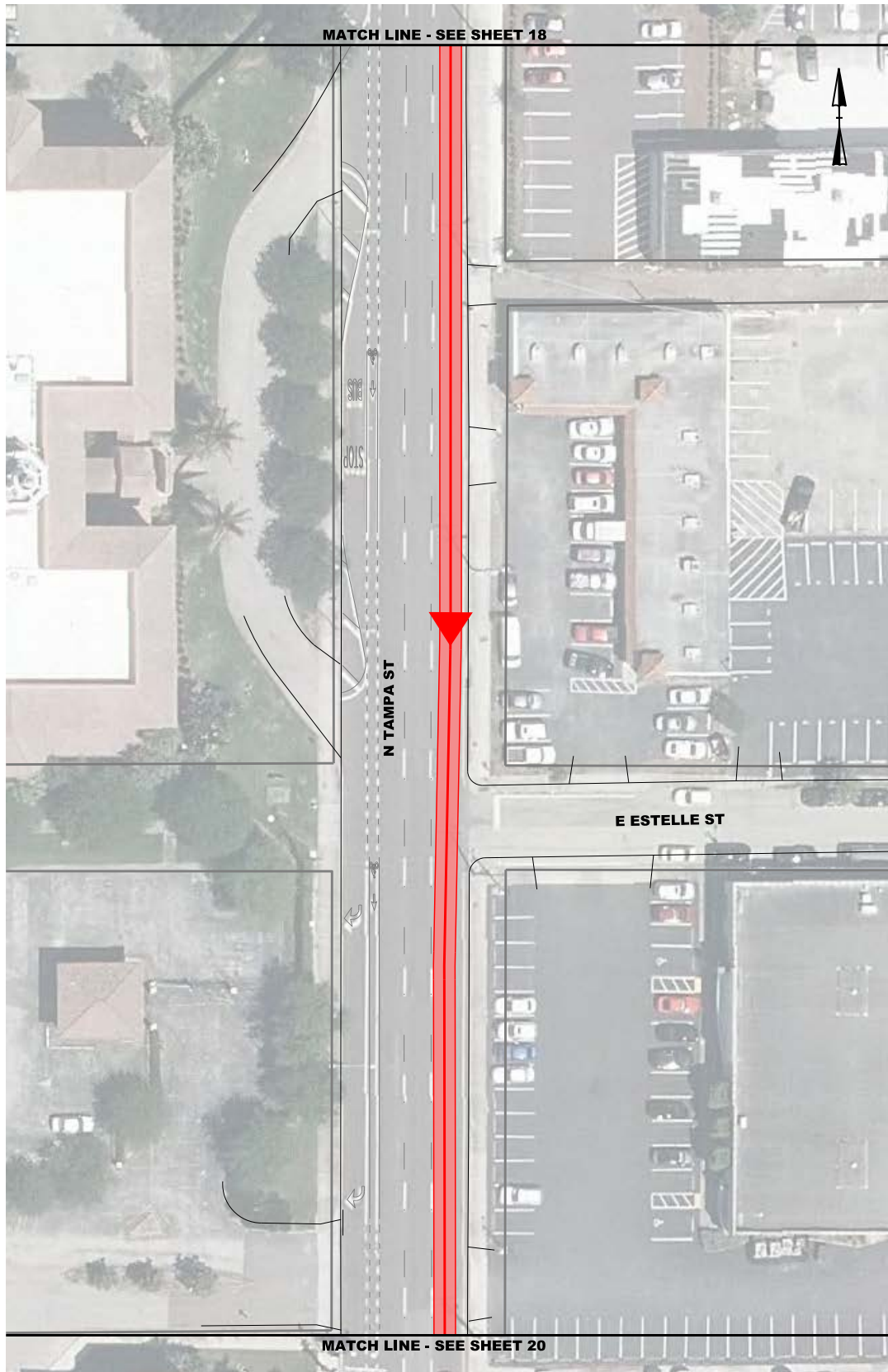


Figure 21. Extension Guideway & Stops - Sheet 20

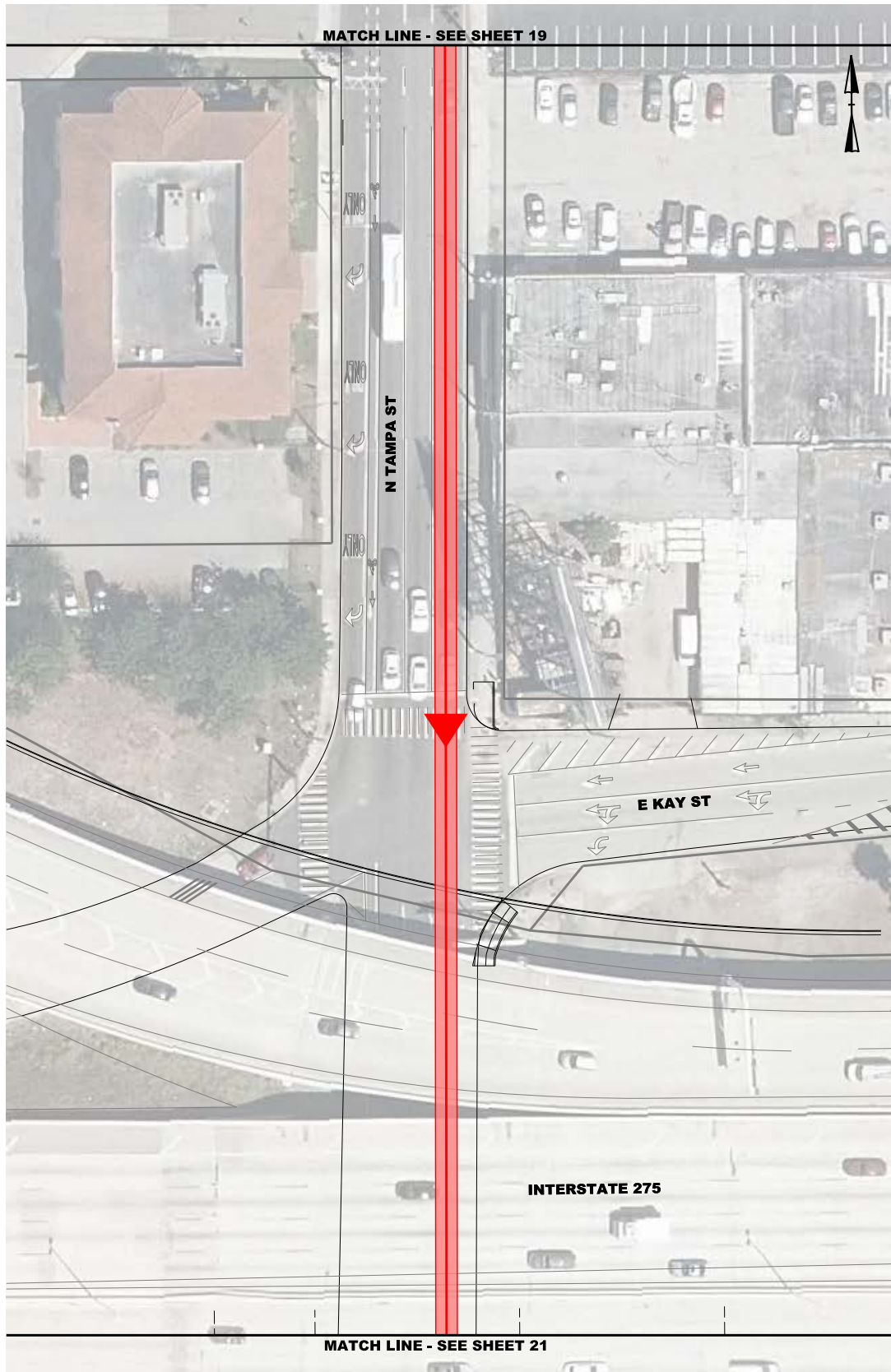


Figure 22. Extension Guideway & Stops - Sheet 21



Figure 23. Extension Guideway & Stops - Sheet 22

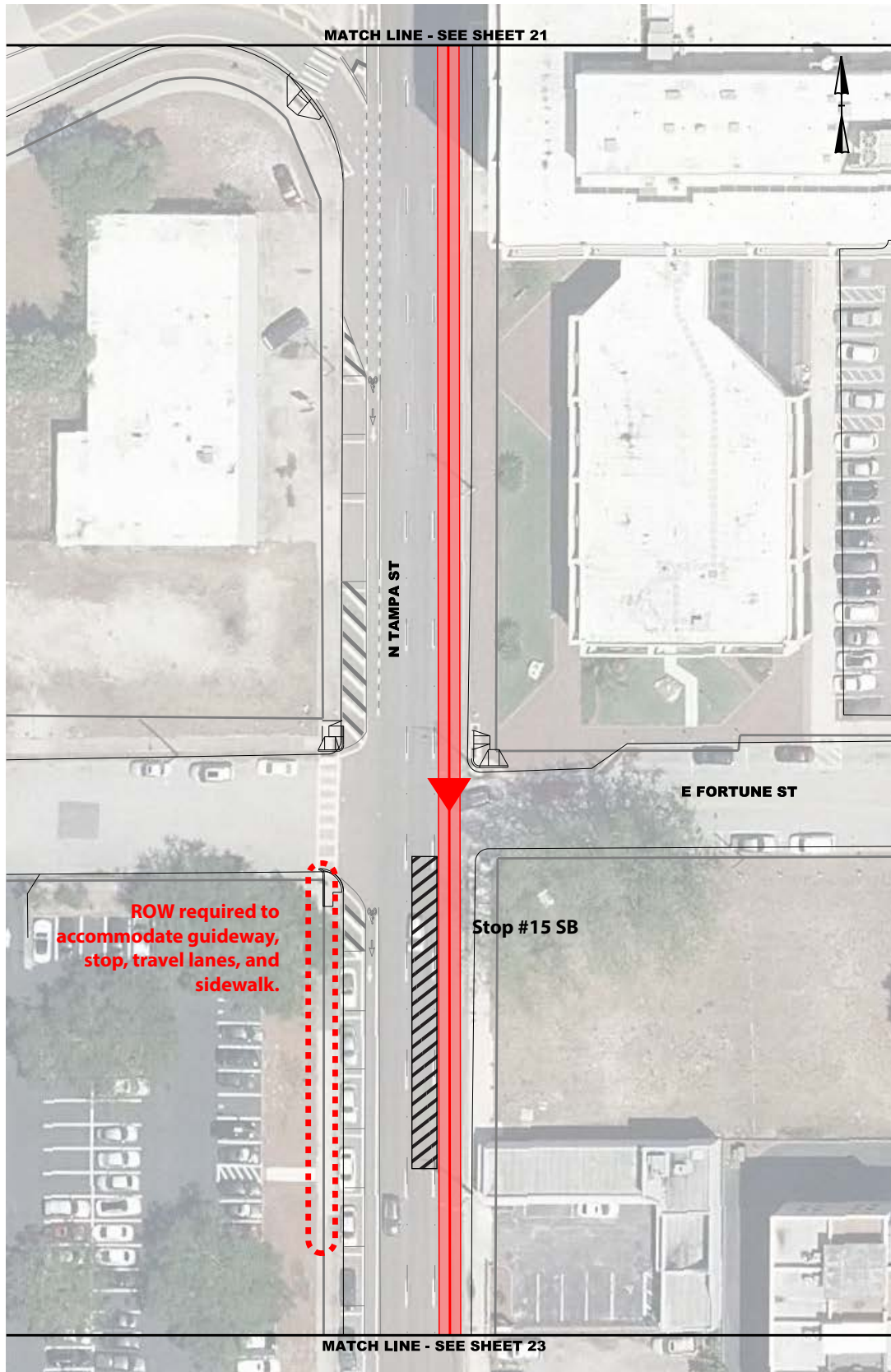


Figure 24. Extension Guideway & Stops - Sheet 23

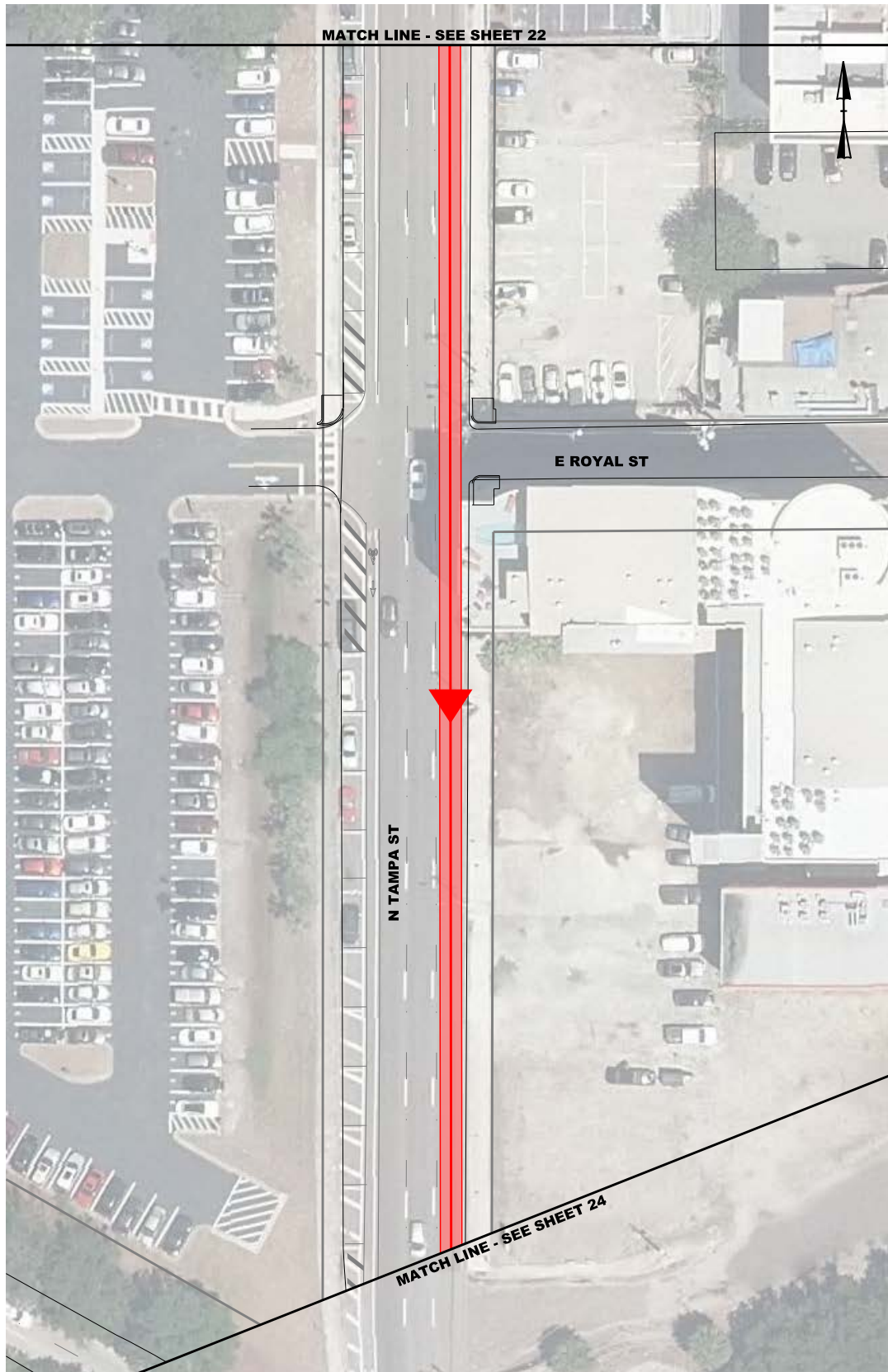


Figure 25. Extension Guideway & Stops - Sheet 24

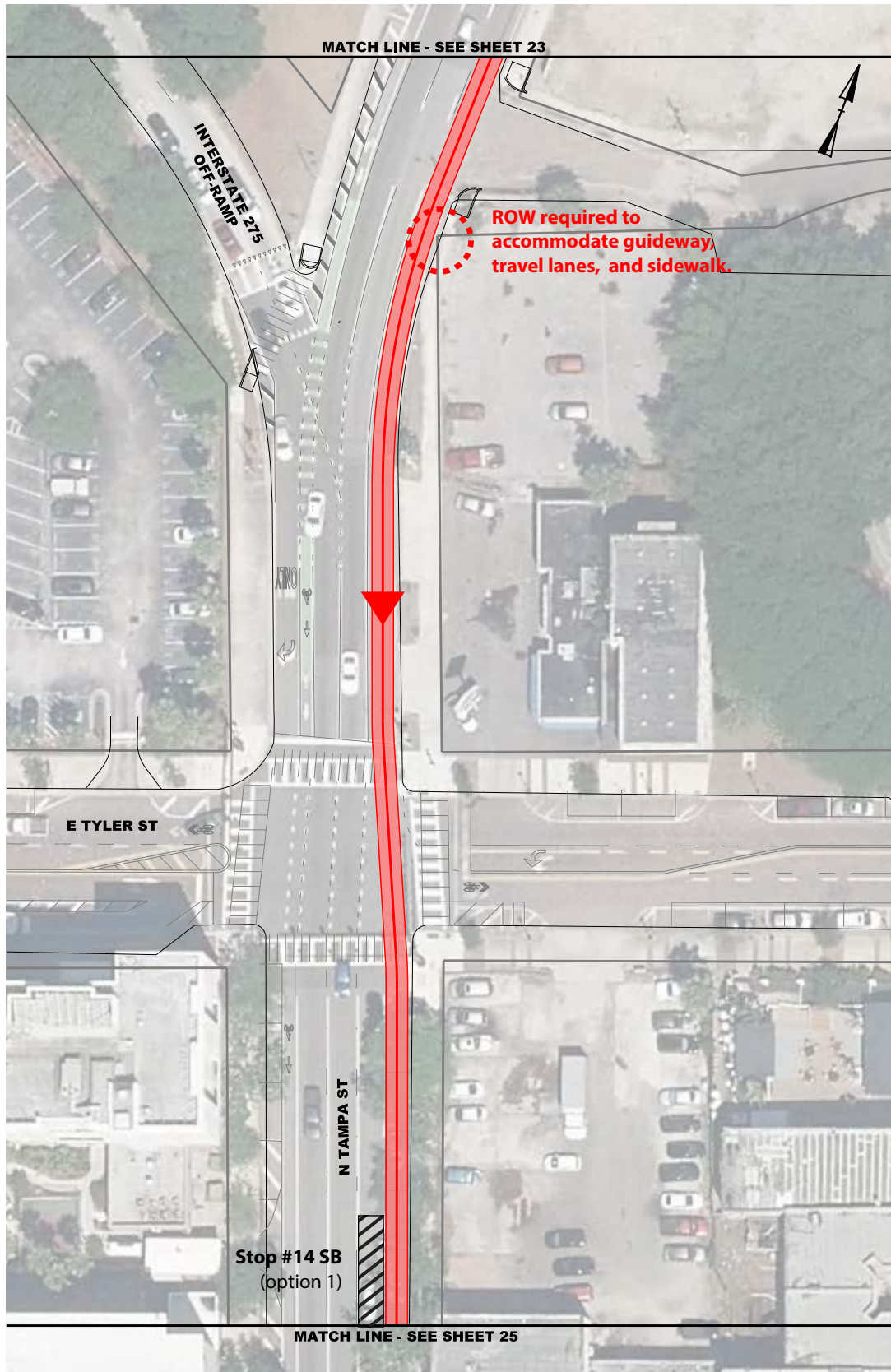


Figure 26. Extension Guideway & Stops - Sheet 25

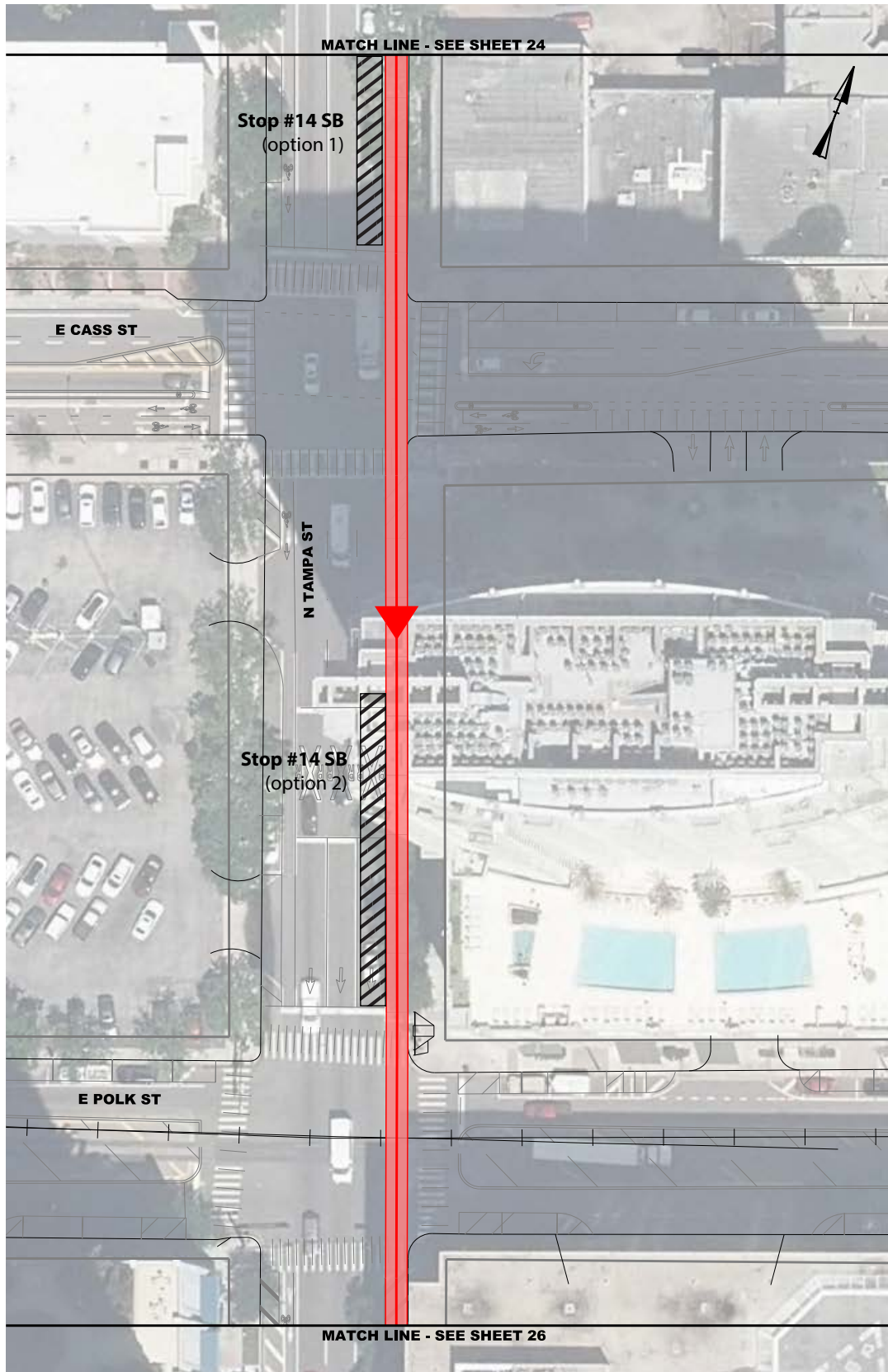


Figure 27. Extension Guideway & Stops - Sheet 26



Figure 28. Extension Guideway & Stops - Sheet 27



Figure 29. Extension Guideway & Stops - Sheet 28

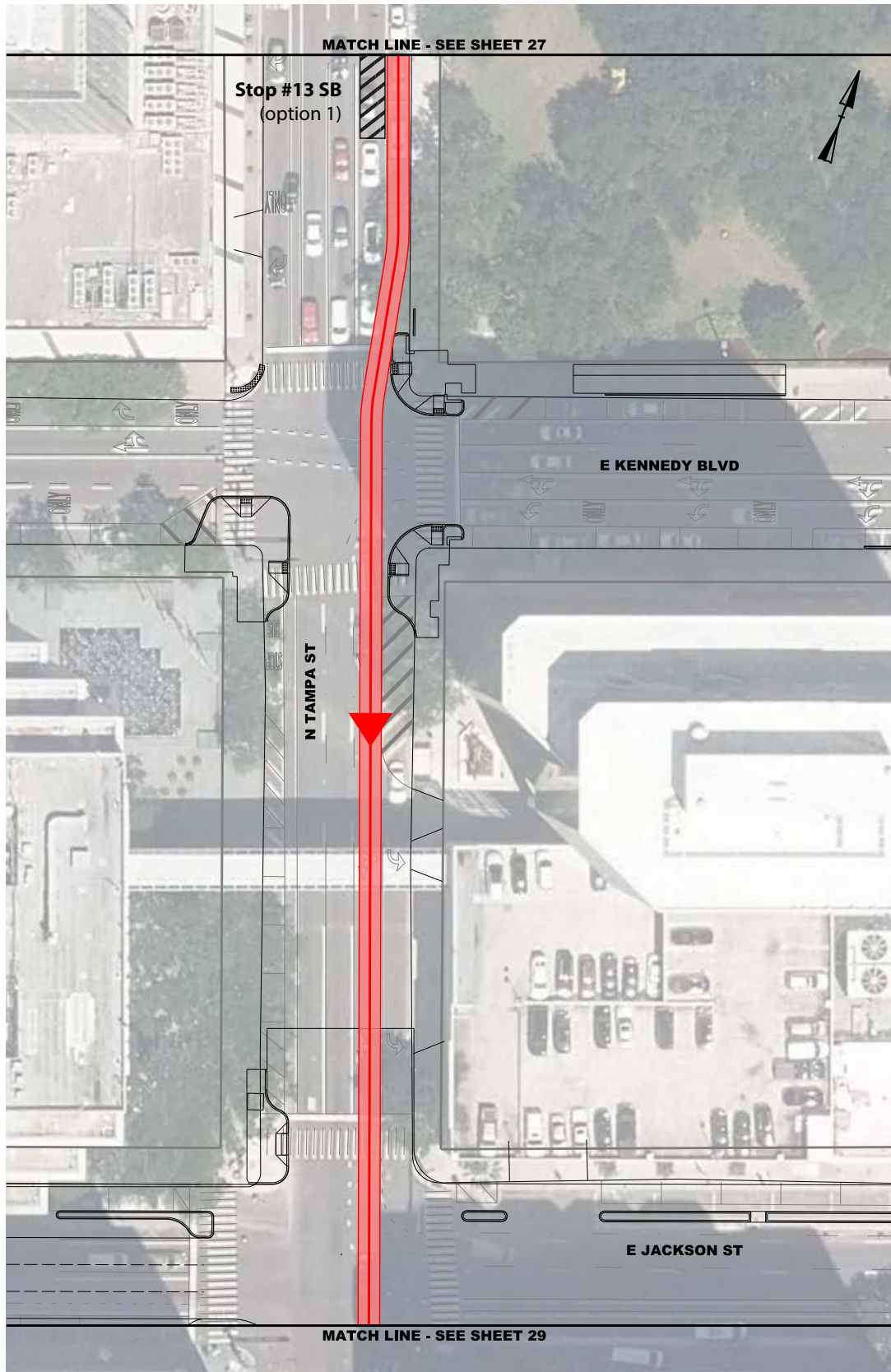


Figure 30. Extension Guideway & Stops - Sheet 29



Figure 31. Extension Guideway & Stops - Sheet 30

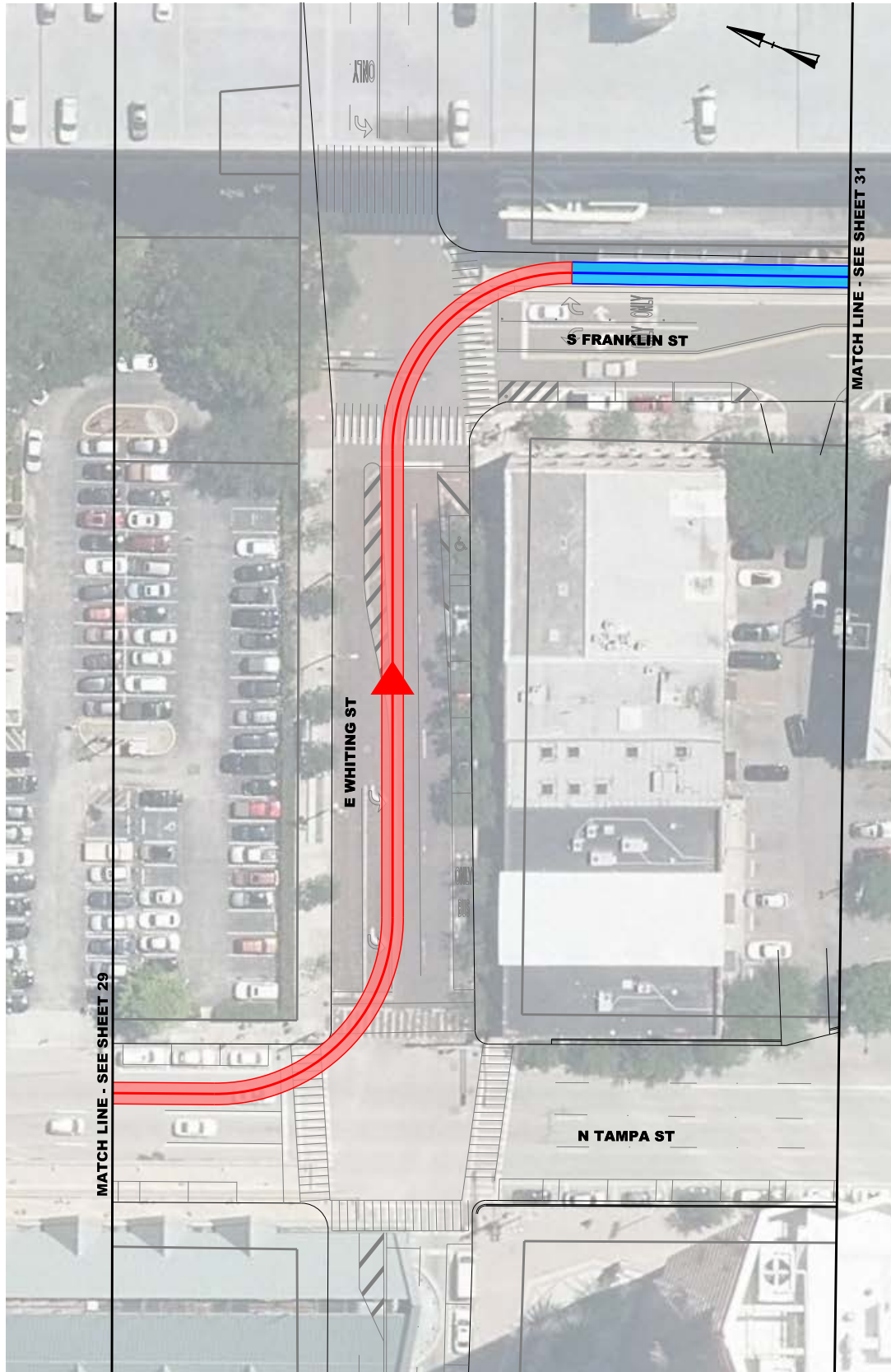
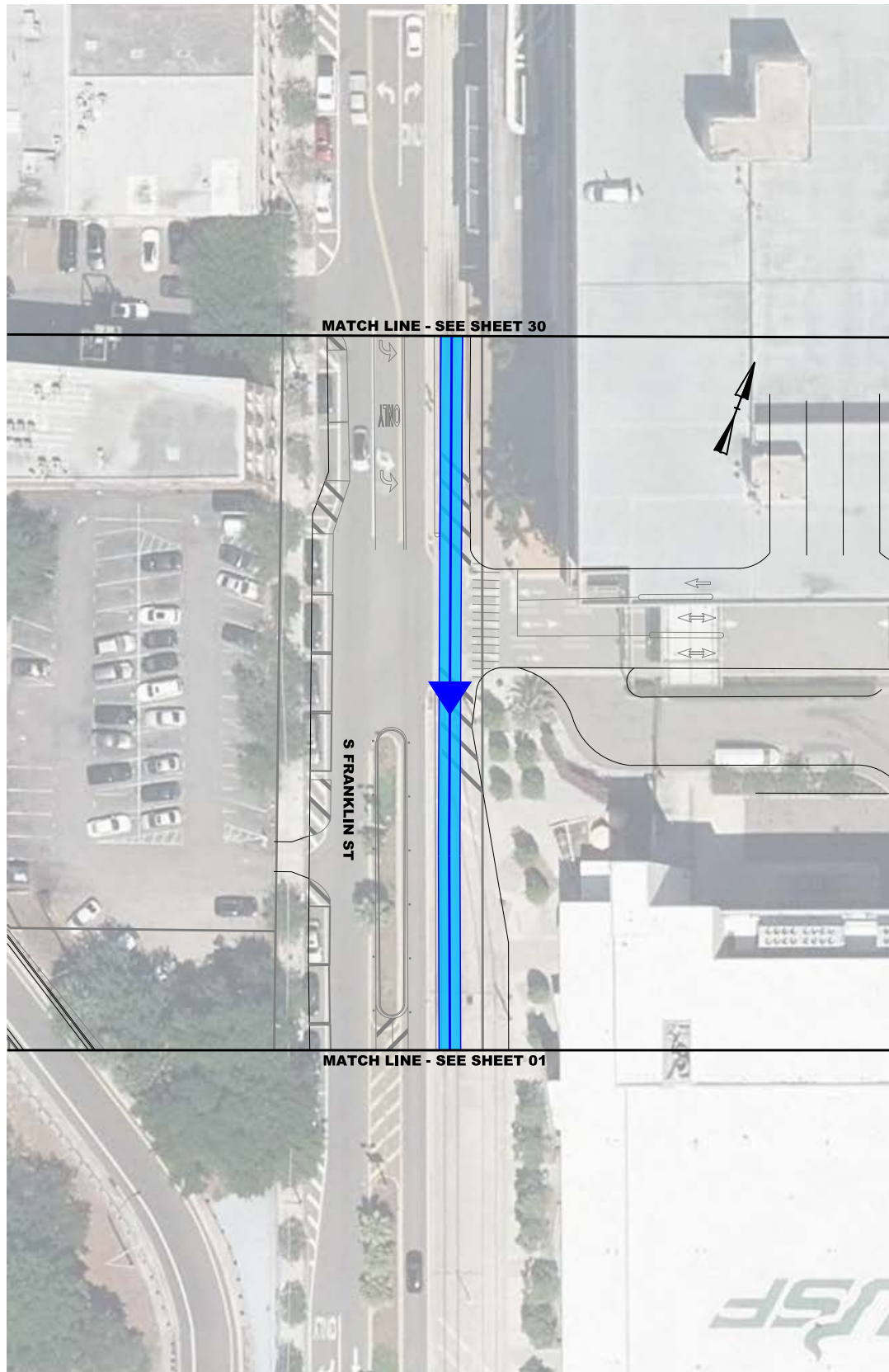


Figure 32. Extension Guideway & Stops - Sheet 31



APPENDIX C - EXISTING GUIDEWAY MODIFICATIONS

Figure 2. Existing Guideway Modifications - Sheet 01

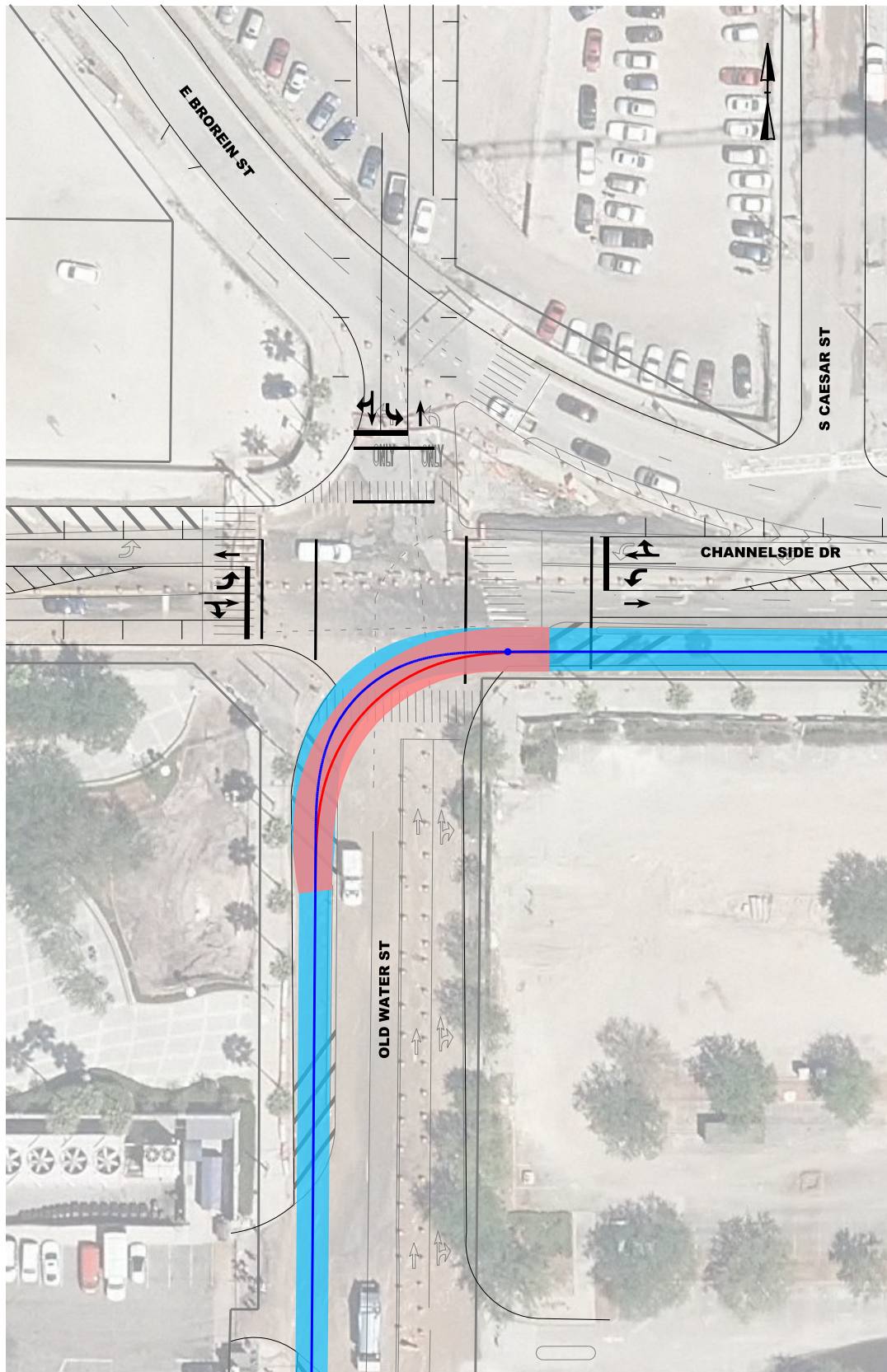


Figure 3. Existing Guideway Modifications - Sheet 02

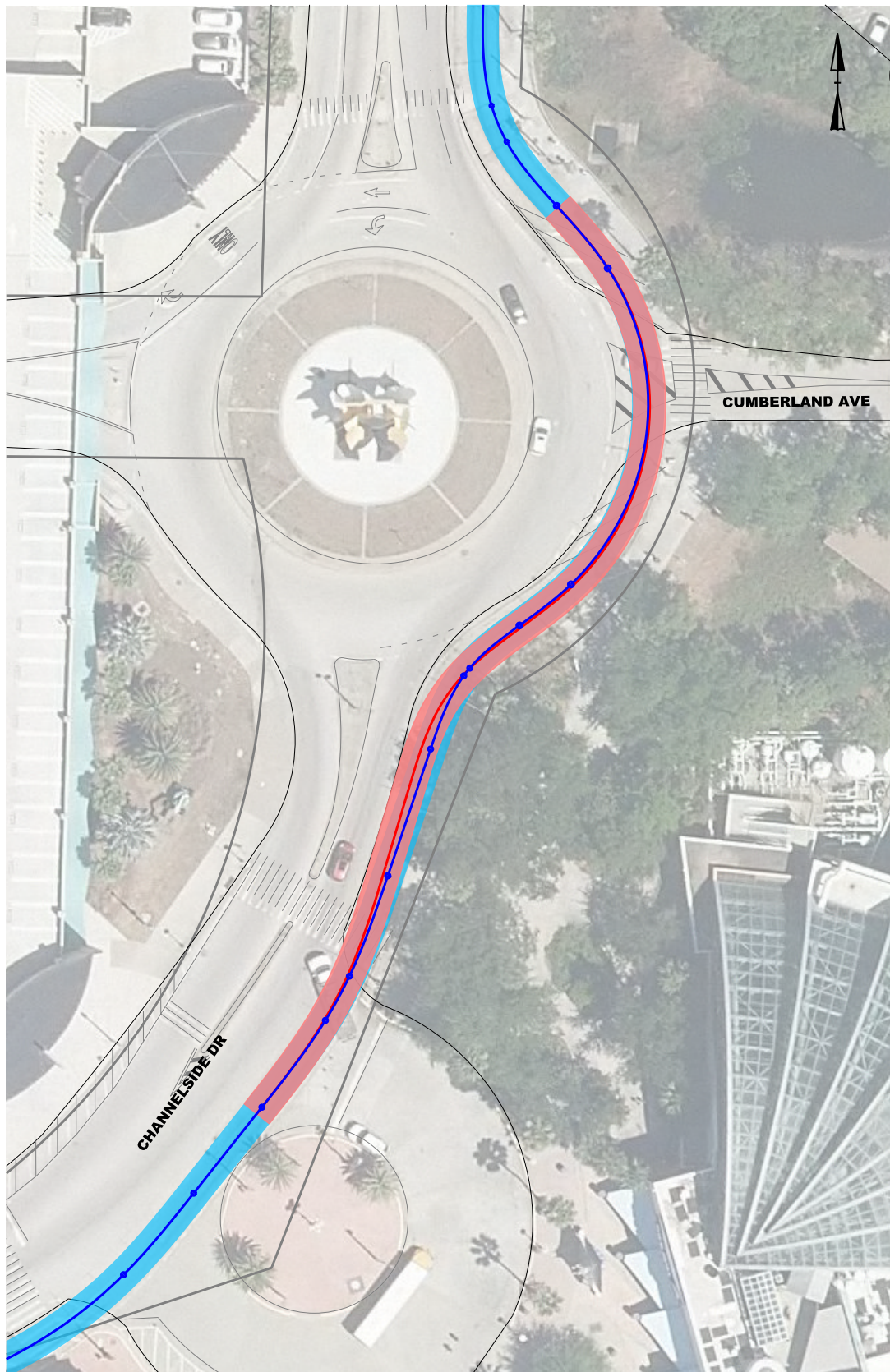


Figure 4. Existing Guideway Modifications - Sheet 03

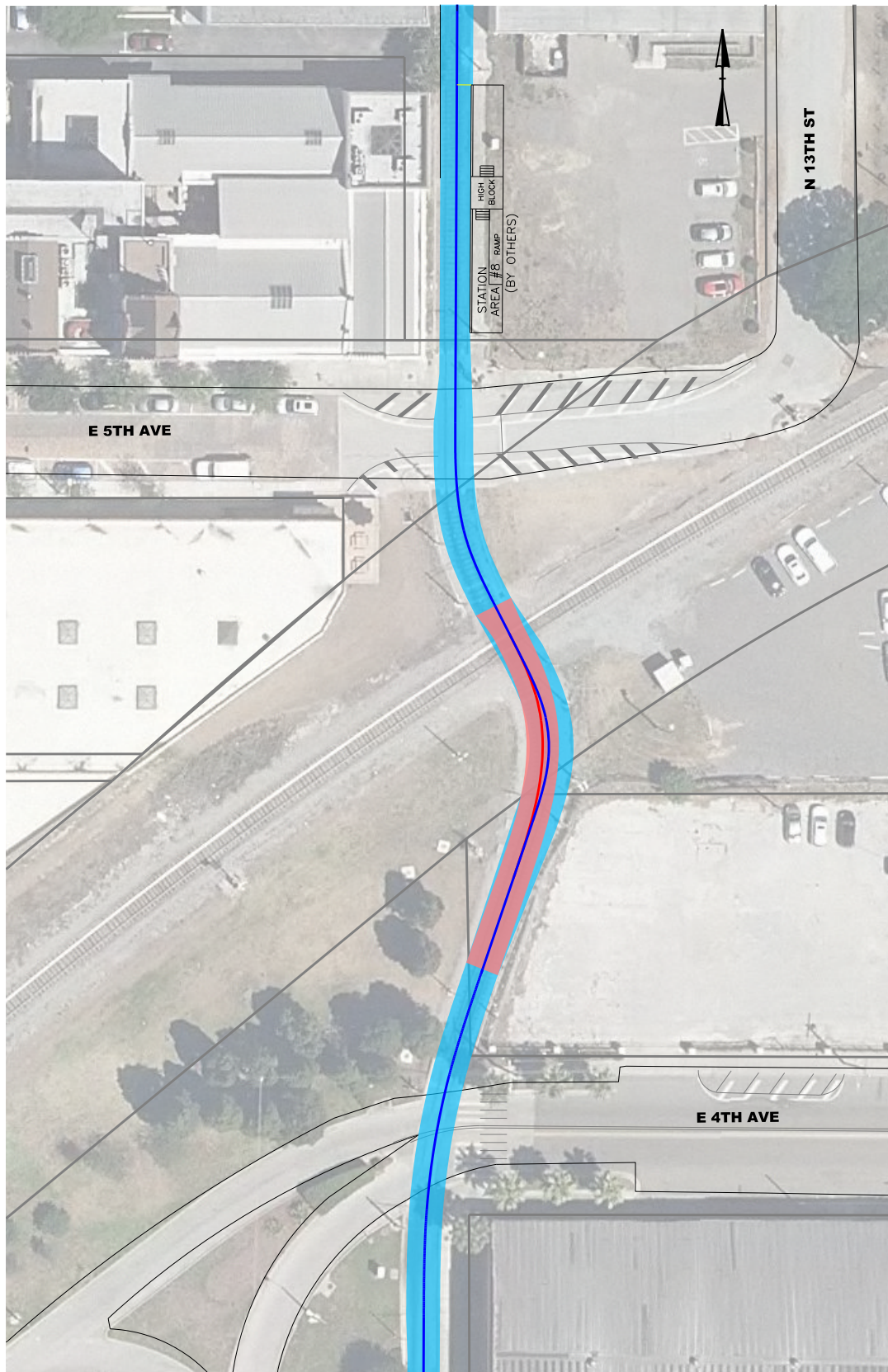


Figure 5. Existing Guideway Modifications - Sheet 04

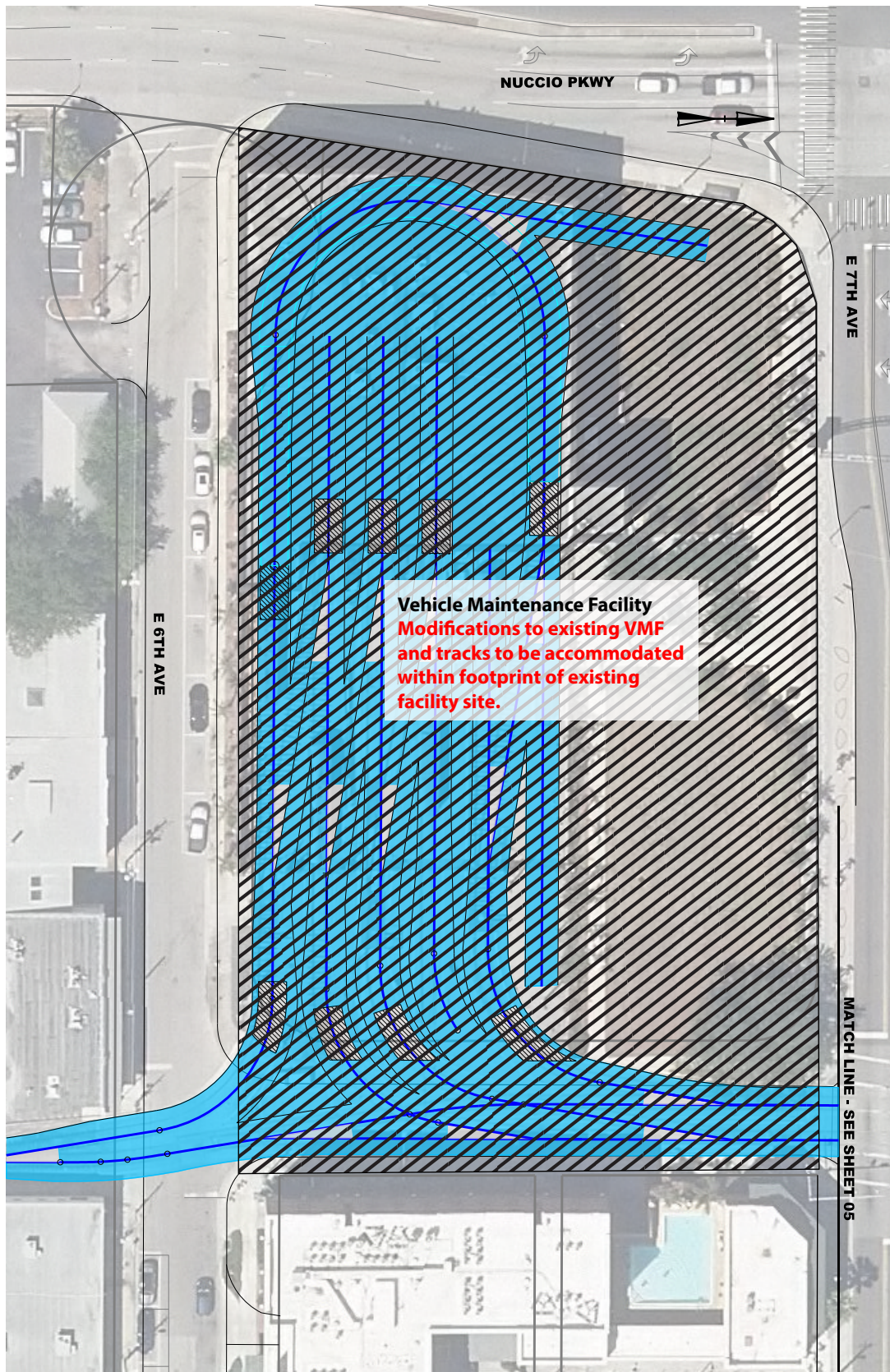


Figure 6. Existing Guideway Modifications - Sheet 05

